Texas International Oilfield Tools, Ltd.

Diesel Hydraulic Power Unit

Air and Electric Start

Installation, Operation and Maintenance

Table of Contents

Specifications……4

Safety Issues……..7

Component Locations……..9

Hydraulic Circuit Diagram……11

Hydraulic System Functioning……..12

Hydraulic Connections……...13

Installation……...14

Operation…….15

Adjustment……...16

Service……...18

Hydraulic System Troubleshooting……19

Electrical System Troubleshooting…….21

Deutz Engine Installation, Operation and Maintenance Instructions……..…….Appendix A

LOFA Engine Panel Operation, Troubleshooting, Circuit Diagrams……...Appendix B

Muncie Hydro-Throttle Installation, Adjustment, Parts List and Troubleshooting……Appendix C

Metaris Gear Pump Code Book Extract……Appendix D

Parker Filter Data……Appendix E

ISO Fluid Cleanliness Levels……...Appendix F

Texas International Oilfield Tools, Ltd.
Diesel Hydraulic Power Unit Specifications

Length	110-1/2 inches
Width	52 inches
Height	62 inches
Frame	ASTM A36 steel construction
	Skid eyes both ends
	Lift eyes on top
	Fully welded belly pan
	Removable drain plug
	Full length forklift tubes
	Removable top
Weight, dry	3709 pounds
Weight, full	4821 pounds
Engine	Deutz F6L914 Air Cooled 6 Cylinder Diesel
	119 horsepower @ 2500 rpm
	295 ft-lbs torque @ 1500 rpm
	Air or Electric Start

Hydraulic tank capacity	135 gallons maximum 118 gallons working Sight and temperature gages Filtered breather Top access hatch Fully welded steel construction
Diesel tank capacity	35 gallons maximum 33 gallons working Top access filler Fully welded steel construction
Performance	47 gpm @ 1800 rpm 66 gpm @ 2500 rpm 6 gallons per hour fuel consumption at maximum output (approximately) Maximum operating pressure 2500 psi (higher available)
Pump	Single stage, heavy duty gear type pump 6.38 cu in/rev SAE B mount SAE C splined shaft
Oil Cooler	Oil / air type, brazed bar & plate construction Oversize cooler for hot climate use Low pressure drop (< 18 psi) at max flow Adjustable fan speed
Filtration	Full flow return line Dirty element / No element / Operation OK sight gage

Remote start / stop if desired

Standard gages	Output pressure, 0 – 3000 psi, oil filled Tank temperature

Standard gages cont'd	Tank level Filtration status
Optional gages	Voltmeter Engine Temperature Engine Oil Pressure Engine hour meter Tachometer
Battery (Electric start only)	Group type 8D, heavy duty 12 volt commercial battery 1300 cold cranking amps at 0 F., 1560 cold cranking amps at 32 F. 435 reserve capacity minutes at 25 amps 20-3/4" L X 11" W X 10" H

Adjustable relief valve factory set at 2500 psi

Safety Issues

1. Location – always insure the unit is properly located away from hazardous vapor sources, in a solid, level location.

2. Electrical wiring –Insure that connections are properly made, that there are no breaks in the insulation, and that cables are running where they won't be cut, nicked or squeezed during operation.

3. Cooling – always operate the unit with cooling fan properly adjusted. The temperature of the oil will increase 80 degrees Fahrenheit in 20 minutes without air flow from the fan.

4. Hot surfaces and fluids – the hoses, pump, motor and tank surfaces can get quite warm during normal operation, as does the hydraulic oil. Use proper cooling to keep the operating temperature between 100 and 130 degrees Fahrenheit. Avoid contact with hot surfaces and oil.

Approximate Times And Temperatures Causing A Third-Degree Burn[13,14,15]

TEMPERATURE	ADULTS	CHILDREN 0-5 YEARS
	skin thickness of 2.5 mm	skin thickness of 0.56 mm
160°F	1 second	0.5 seconds
155°F	1.5 seconds	1 second
150°F	2 seconds	1.5 seconds
145°F	3 seconds	2 seconds
140°F	5 seconds	3 seconds
135°F	15 seconds	4 seconds
130°F	35 seconds	10 seconds
125°F	3 minutes	2 minutes
120°F	10 minutes	5 minutes
100°F	Safest Water Temperature for Bathing	

Information gathered from:

[14]*Hot water burn and scalding graph. (2004) Retrieved June 20, 2005, from Hot Water Burn Prevention and Consumer Safety Web site: http://www.accuratebuilding.com/services/legal/charts/hot_water_burn_scalding_graph.html.*

[13]*Christophersen, Ph.D., E.R. (2004). Burn safety: hot water temperature. Retrieved June 20, 2005, from Pediatric Advisor Health Library Web site: http://www.fairview.org/healthlibrary/content/pa_hotwatr_hhg.htm.*

[15]*Scalds: a burning issue. (n.d.). Retrieved Aug. 10, 2005, from http://www.ameriburn.org.*

High temperatures decrease the useful life of the hydraulic oil, the hoses and the seals in the equipment being powered. Very high temperatures can cause burns, as shown on the previous page.

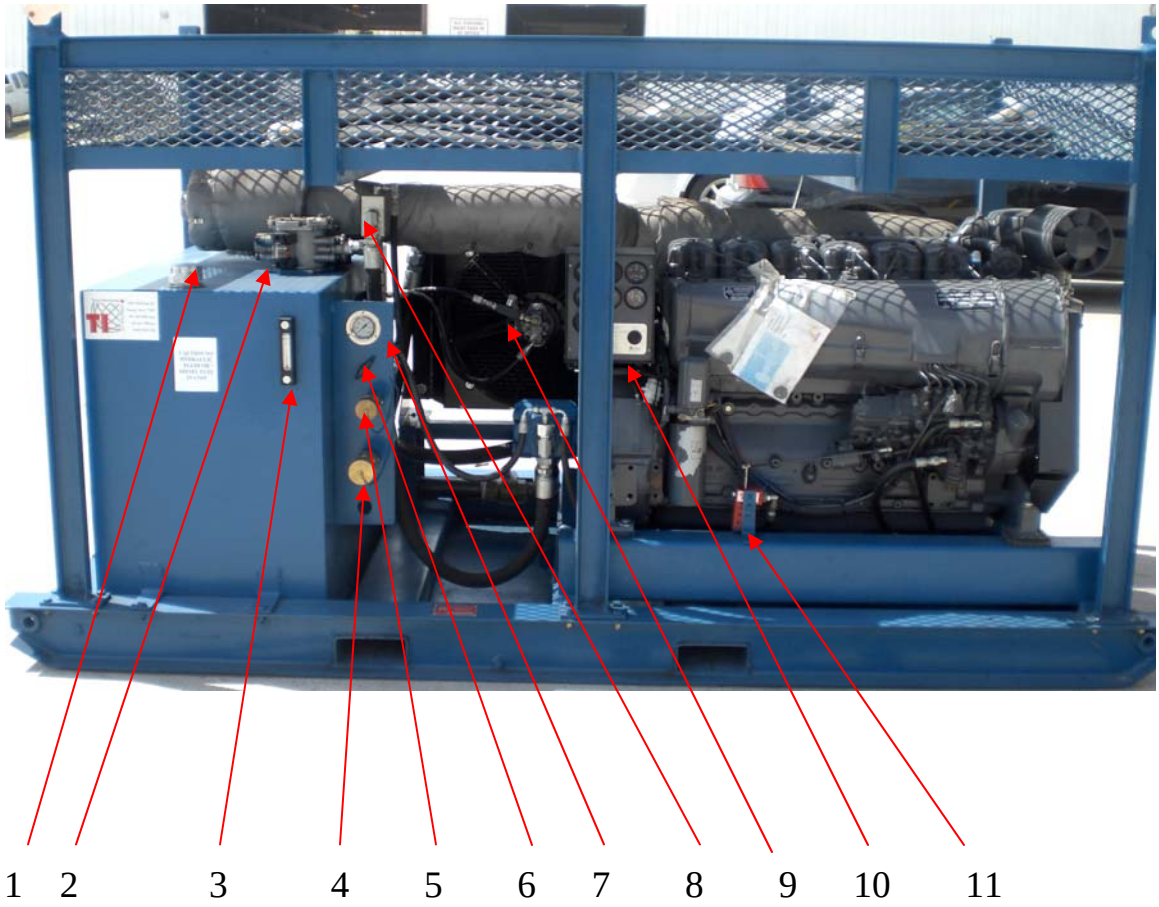
5. Mechanical parts – don't allow items like clothing or tools close to the accessory drive. Don't let items intrude into the fan at the front of the engine. The engine develops nearly 300 foot pounds of torque while running, and foreign objects can be drawn in with great power at rapid speed. Keep foreign objects away from these areas.

6. Safety lockout – use a safety lockout device or disconnect the battery or air when servicing the unit.

7. Lifting – use only the lift eyes provided. If the unit is full of hydraulic oil the center of mass is approximately in the center of the forklift tubes. If the unit is empty, the center of mass is still between the forklift tubes, but biased to the motor end. Don't use the top lifting eyes unless all bolts holding the top to the frame are properly installed.

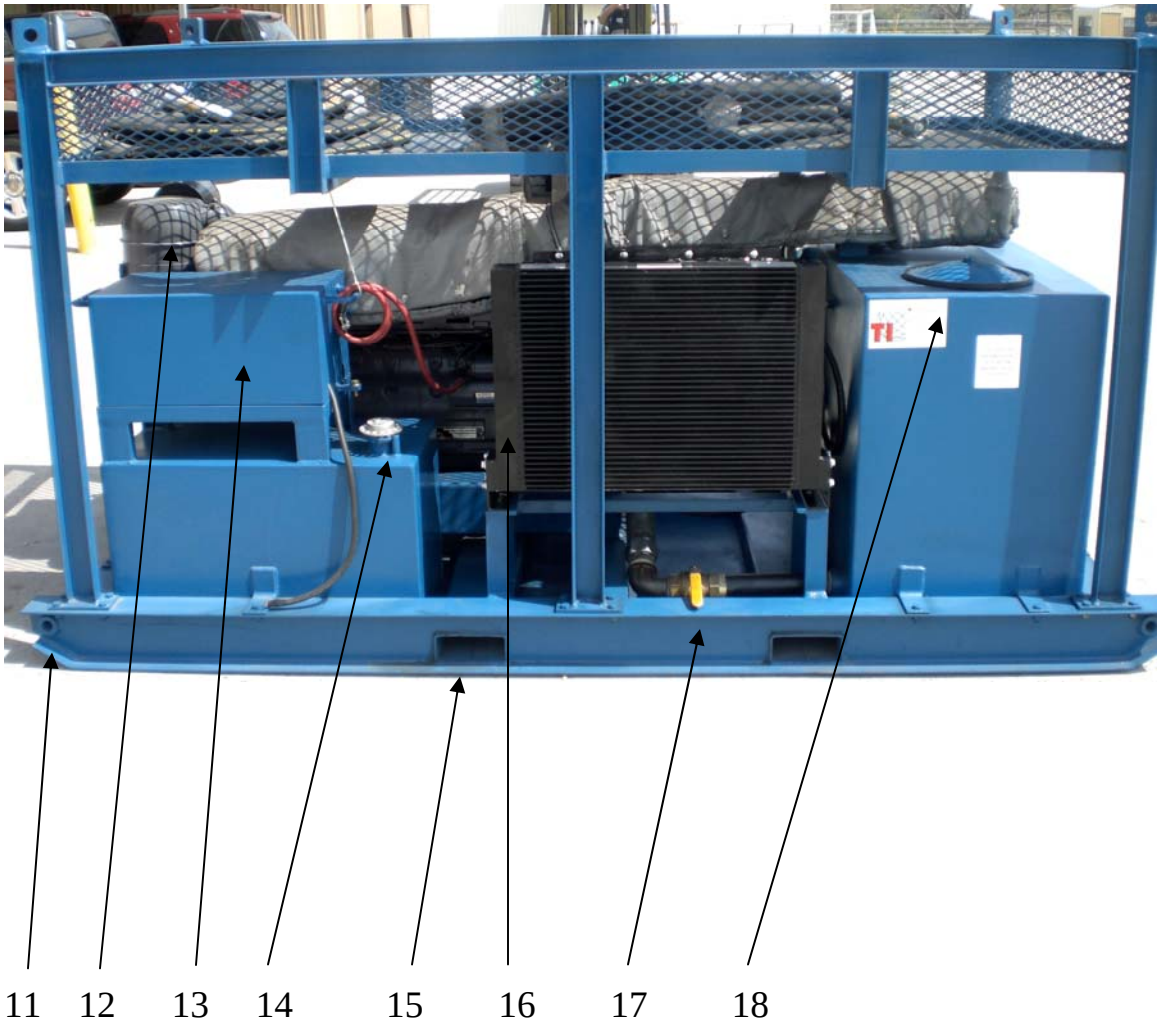
8. Fluid levels – Low hydraulic fluid level can cause overheating, or in worst cases severe damage to the pump and even the associated tools it's driving. Keep fluid up to at least the minimum on the sight gage. Observe the filtration monitor to be sure it's operating in the green (OK) range. Change the filter if it's not.

9. Pressure leaks – High pressure fluid can cut as effectively as a knife. Oil forced into your body will be harmful. NEVER check a leaking high pressure line by putting your hands or fingers near the leak. Stop the unit, bleed off any pressure as required before checking or fixing any high pressure leakage.



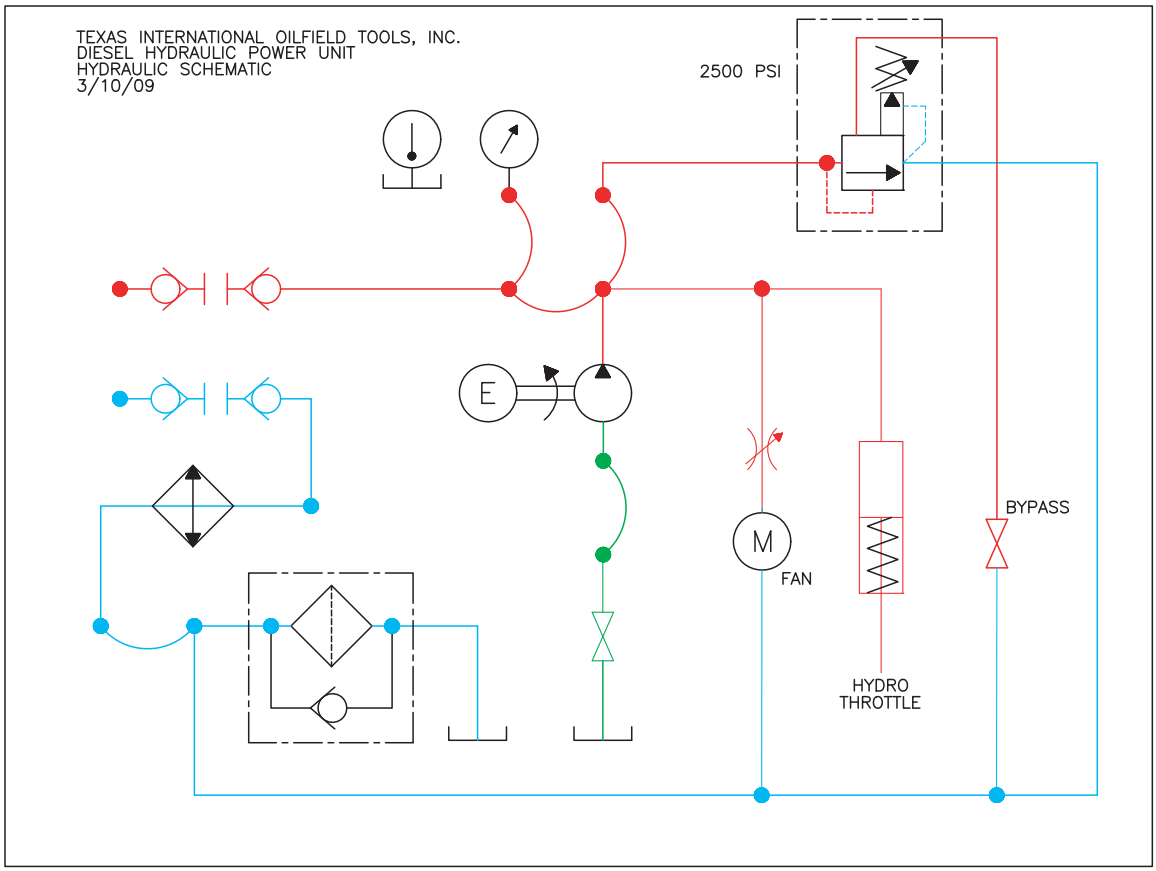
Component Locations

1. Breather cap and fill neck
2. Full flow return filter
3. Level gage and fluid thermometer
4. Return disconnect
5. Pressure disconnect
6. Bypass control
7. 0 – 3000 psi pressure gage
8. Relief valve (back side of block)
9. Cooling fan needle control valve
10. Gage panel / starting key
11. Hydro-throttle control



Component locations

11. Skid eyes (4)
12. Air cleaner
13. Battery box (electric start only)
14. Diesel tank filler neck
15. Forklift tube
16. Air / oil cooler
17. Tank outlet to pump inlet shutoff valve
18. Tank cleanout cover



Hydraulic Circuit Diagram

Red lines are pressure lines, aqua (blue) lines are return lines, green lines are suction lines.

Hydraulic System Functioning

The diesel engine drives the single stage pump at a setting of 1800 rpm. The pump draws hydraulic fluid from the tank and delivers hydraulic fluid up to 2500 psi on the pressure line, adjustable at the relief valve. The pump delivers 47 gpm at 1800 rpm, and 66 gpm at the engine's maximum speed of 2500 rpm.

The engine is controlled by the hydro-throttle, which opens the throttle as the load increases.

When the bypass valve is opened, the relief valve is vented directly back to tank - output pressure is not available.

The 2500 psi setting is the maximum recommended output pressure for the standard pump. Theoretically the unit could produce more at full engine rated output, but pump life will be shortened, possibly dramatically.

The unit is slightly overpowered for long service life. Exceeding the factory set pressures is not recommended.

Cooling is provided on the return line with an oversized air to oil cooler. The cooler is capable of removing nearly half the entire horsepower rating in heat, so keeping hydraulic temperatures low for safety and for system longevity is easily achieved with a reasonable flow of cooling air. Controlling the temperature is done by manually adjusting the flow rate of oil to the fan motor while observing the thermometer in the sight gage mounted on the tank.

Full filtration is provided on the return line. The filter is mounted on the top of the tank, and has a filter condition indicator mounted on the side of the filter housing. The condition indicator shows when the filter is operating properly, is bypassing (dirty filter), or is missing. Keeping the filter in good condition is strongly recommended, as dirt in the system will increase wear in the pump, valving and connected tongs or other hydraulic tools.

Hoses and fittings have JIC swivel connections, SAE flange connections, or NPT connections. There is a shutoff valve on the tank so it can be drained and serviced.

Hydraulic Connections

The power unit is equipped with Snaptite 78 series quick disconnect couplings (or equivalent), 1 inch for the supply line and 1-1/4 inch for the return line. These couplings contain check valves to prevent the loss of hydraulic oil during connection and disconnection. Proper connection is required to fully open the check valve. Connect the hoses as follows:

1. Wipe the connections clean as required to remove dirt and dust.

2. Connect the 1 inch pressure hose to the 1 inch coupling on the unit by engaging the mating coupling halves and forcing the connectors together while rotating the threaded sleeve on the hose connector. Full thread engagement is necessary for the check valve to be fully open.

3. Using the same method as used for the 1 inch hose, connect the 1-1/4 inch return hose.

NOTE: DO NOT attempt to connect hoses with the engine and pump running. Be sure it is off and that no one can turn it on by mistake.

If either the pressure or return fittings are not fully tightened, the check valve will cause a restriction in the flow. This can result in overheating the fluid, poor tool operation and damage to equipment.

Hoses, connections and fittings should be chosen carefully so as not to cause excessive restriction. Restriction in a hydraulic system equals pressure drop, and pressure drop equals heat. Choose short, large inside diameter hoses whenever possible over long, skinny ones.

Improper connection or restrictive circuits can cause a serious loss of power and will generate heat uselessly.

Installation

The diesel hydraulic power unit requires a location where adequate air flow and exhaust removal are available. It's important to consider hydraulic line losses from size, length and head in choosing where to put the unit. The sizes of the hydraulic lines should be large enough to limit friction losses to 300 psi or less. This may mean using hoses larger than the connections on the unit.

There should be at least three feet between the oil cooler and any wall or obstruction. In the best conditions it will be facing open air.

The presence of hazardous locations should be compared with the rating of the power unit for compatibility.

Ideally the unit will be located in a non-hazardous location, with excellent ventilation, as close as possible to the equipment to be powered.

Transport the power unit using the only the lifting eyes, skid eyes or forklift tubes provided. Attaching lifting slings to other points, or positioning forklift forks in other positions can damage the unit and can be dangerous to personnel.

Measures should be taken to insure the unit does not shift or move from its intended position.

Always take care around the accessory drive on the front of the engine ! The motor develops almost 300 foot-pounds of torque and at 1800 rpm loose clothing, long hair, etc., can be drawn in with incredible speed and power - with disastrous results. Place the unit so personnel can pass easily around this area.

Diesel exhaust can be lethal ! Be sure that ventilation can carry away the exhaust fumes.

Operation

The unit comes preset from the factory with the relief valve set at 2500 psi. See the “Adjustment” section on page 16 of this manual for how to change this setting.

1. Review the Deutz engine manual, Appendix A, for detailed instructions on start up, shut down and operation of the engine.

2. Check the condition of all hoses. Look for worn or scraped areas, bubbles, wrinkles or any other indication that the hose may need replacement.

3. Be sure the tank is filled to the proper level with the specified hydraulic oil. Be sure the shutoff valve to the pump inlet is fully open.

4. Insure the diesel tank has adequate fuel for the intended operations. Refueling is most safely done with the engine OFF. Clean up any spills.

5. Verify that the equipment to be operated is properly connected to the power unit as specified in the “Hydraulic Connections” section on page 13.

6. Be sure the equipment being operated is an “open center” hydraulic circuit. This means that in the neutral position the circuit has full flow from the inlet to the outlet. If not, a “closed center” adapter must be installed.

7. Verify that cooling air can freely flow through the oil cooler.

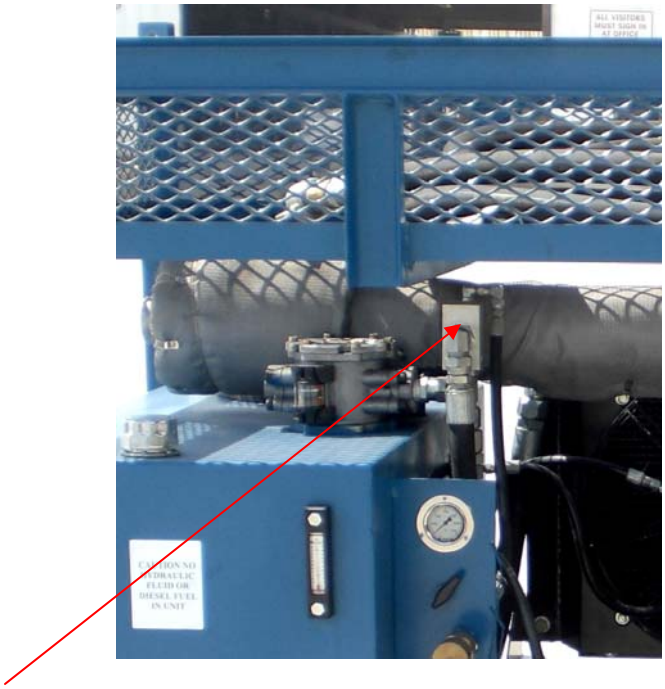
8. If disconnected, connect the battery or air supply. Turn the key to the ON and then the START position on the main enclosure or on the remote start/stop switch, or pull the "Engine Start" knob for air start units.

9. To turn the unit off, turn the key to OFF or press the “Stop” button.

10. If the power unit shuts down prematurely, verify that there is fuel in the fuel tank. If this happens repeatedly there is an abnormal condition which must be found and fixed before continuing operation.

Adjustment

Adjustments should be made with the oil at normal operating temperature of 80 to 130 degrees F.



Relief valve adjustment screw (back side of this block)

The adjustment for the relief valve is located as shown above. Turning the adjustment screw clockwise (in) raises the relief pressure: turning it counterclockwise lowers the relief pressure. The screw takes a 5/32" Allen wrench: the locknut for the screw a 9/16" wrench.

The relief valve setting can be determined by operating the unit with no equipment connected to the quick disconnects, the bypass closed, and observing the pressure reading on the panel gage.

DO NOT OPERATE THE UNIT WITH EQUIPMENT DISCONNECTED FOR OVER FIVE MINUTES. THINGS WILL GET VERY HOT.

It is NOT recommended to exceed the factory setting of 2500 psi. Doing so will shorten the life of the pump, perhaps dramatically.

Adjustment (continued)

Fan speed needle valve adjustment

Rotating the needle clockwise (viewed from the top) slows down the fan. Rotating it counter-clockwise speeds the fan up.

Muncie Hydro-Throttle

See Appendix C for adjustment procedure.

Service

Servicing of the power unit consists of periodic inspection, lubrication and if necessary, adjustment. Repairs are covered under the Hydraulic System Troubleshooting section beginning on page 19 or the Engine System Troubleshooting section beginning on page 21.

The unit should be fully inspected at the start of every job.

Daily inspections should look for:

1) Worn, wrinkled, bubbled, leaking or broken hoses or other evidence of damage;
2) Visual evidence of physical damage to the unit;
3) Loose, worn or improper electrical connections;
4) Proper hydraulic fluid level;
5) Once operating, the state of the filter.

As most items in the unit are lubricated by the hydraulic fluid, they don’t require other lubrication than to insure the hydraulic fluid is clean.

The engine does require periodic oil and filter changes. Under moderately dirty conditions the engine oil should be changed every 500 hours. Under severe conditions this should be done every 250 hours.

Hydraulic oil should be a good quality mineral based ISO VG 46 hydraulic oil, such as Mobil DTE 25. Many others are suitable as well. Use of vegetable based, water based hydraulic fluids or the like may damage the pump and valving.

Hydraulic System Troubleshooting

Additional troubleshooting info is available in the appendices covering individual components.

Problem	Corrective action
Pump excessively noisy.	
Suction side plumbing is restricted or blocked.	Insure that no foreign matter is blocking the tank outlet by removing the access hatch and looking inside.
	Verify suction shutoff valve is wide open.
Viscosity of oil is too high.	Change the oil to a lower ISO VG grade.
Air in suction side.	Pour oil over suction side fitting connections. If noise stops, disassemble fittings, re-tape and re-assemble.
Loose or worn out parts.	Verify assembly is properly tightened, replace worn out parts.
Hydraulic system overheating.	
Insufficient cooling air.	Verify air flow rate is unobstructed. Open needle valve fully.
Relief valve setting too high.	Reset relief valve to a maximum of 2500 psi.
Viscosity of oil is too low or too high.	Change the oil.
Excessive internal leakage.	Check parts for wear and repair or replace as necessary. Check for contamination and clean out crud as needed.
Excess friction.	Check the moving parts inside the pump for tightness and proper fit. Repair as required.
Leaks in pump, high volume check valve, unloader valve, relief valve.	Repair or replace.
Dirty heat exchanger.	Clean out oil and air passages.
Excessive wear of moving parts	
Abrasive contaminants in oil.	Clean and flush system. Replace filter element. Clean breather. Replace fluid.
Engine to pump alignment off.	Verify fastener tightness. If OK, replace motor to pump housing and coupling.
Operating pressure is set too high.	Reset relief valve lower, to a maximum of 2500 psi.
Viscosity of oil is too low.	Change oil to a higher ISO VG grade.
Leakage of air into the system.	Pour oil over suction side fitting connections. If the oil disappears, disassemble, re-tape and re-assemble.

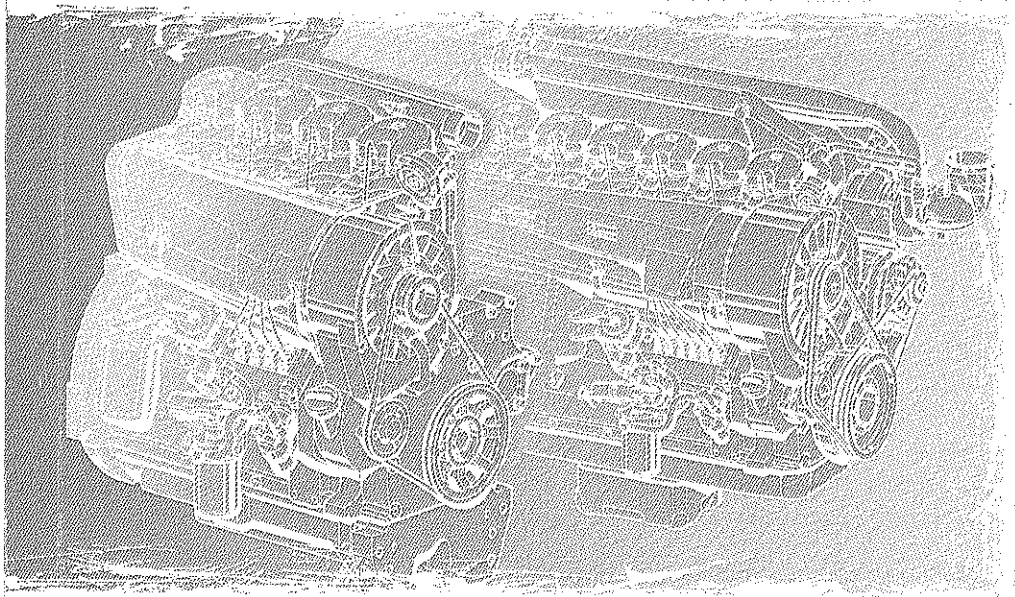
Problem	Corrective action
Flow rate (tool speed) is low.	
Pump inlet flow is restricted.	Insure that no foreign matter is blocking the tank outlet by removing the access hatch and looking inside.
	Verify suction shutoff valve is wide open.
Damaged or worn pump parts.	Inspect the parts and replace as necessary.
Oil is bypassing through relief or unloader valves.	Check relief and unloader valves for proper operation and reset as necessary.
Disconnect fittings not tightened.	Check that fittings are tightened per “Hydraulic Connections” section.
Oil viscosity low or high.	Change to proper viscosity grade.
Plumbing is too restrictive.	Change to larger and/or shorter hoses.
Engine speed is low.	Insure Hydro-Throttle is operational. When supplying pressure engine rpm should be between 1800 and 2500.

Engine System Troubleshooting

Additional troubleshooting info is available in the appendices covering individual components.

Problem	Corrective action
Engine will not start.	
No electrical power.	Verify and repair power connections.
Battery dead.	Recharge battery then find source of drain.
Control circuit wiring incorrect or disconnected.	Verify wiring is correct. Tighten connections.
Air in fuel system.	Bleed fuel system (See Appendix A section 3.1.4.
Engine stalls.	
Control circuit wiring incorrect or disconnected.	Verify wiring is correct. Tighten connections.
Dirty fuel filter.	Replace fuel filter
Air in fuel system.	Bleed fuel system (See Appendix A section 3.1.4.
Engine runs and then slows or stops	
Control circuit wiring incorrect or disconnected.	Verify wiring is correct. Tighten connections.
Engine overloaded.	Adjust or replace hydraulic valves. Be sure hoses are properly connected to tool(s).
Dirty fuel filter.	Replace fuel filter
Air in fuel system.	Bleed fuel system (See Appendix A section 3.1.4.
Engine overheats while running under load.	
Engine overloaded.	Adjust or replace hydraulic valves. Be sure hoses are properly connected to tool(s).
Vents may be clogged preventing proper ventilation of engine.	Check for clogged air vents in fan cover. Remove cover and clean as necessary.
Engine vibrates after corrections have been made.	
Pump mounting housing bolts loose.	Tighten bolt connections to engine and to pump.
Coupling damaged.	Remove and examine coupling, replace damaged components.

Hot or noisy operation.	
Fan rubbing or hitting.	Remove interference with fan cover, etc. Tighten hold down bolts.
Misalignment.	See “engine vibrates” above.
Insufficient oil.	Lubricate engine per instructions in the engine manual.
Deterioration of lubricant.	Remove old oil and lubricate engine per instructions in the engine manual.
Excess oil.	Drain excess oil. Verify oil level.
Engine loose.	Verify engine mounting bolts are tight.



Operation Manual

914

DEUTZ®

NOTICE

This portion of the manual was removed for web publication as the file size was too large, and the graphics not reduceable. Contact TIOT for complete and detailed information.

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LOFA EP250 Operation and Troubleshooting

Introduction

This document provides general information on LOFA Industries EP250 control systems operation and troubleshooting. EP250 control systems are a very flexible platform for diesel engine control, monitoring, and protection, featuring LOFA's powerful First Fault Diagnostics (FFD). After pinpointing the initial failure, FFD stores it in memory and alerts the end user via a single bright LED. FFD monitors battery charge, low oil pressure, high temperature, overspeed and up to three additional contact closure inputs. The field configurable, expandable microprocessor-based solid-state design uses high-power semiconductors instead of outdated electromechanical relays to ensure reliable high-current switching.

The EP250 features LOFA's new modular Function Enhancement Packs (FEP). The plug-and-play FEP modules allow various feature upgrades to be easily added to the standard platform. FEPs include:

- Diagnostic Program Gauge (DPG)
- Auto-Start with Real-time Clock
- Data Logging
- Closed Loop Speed Control
- Precision Actuator Control
- Custom OEM Solutions

The Diagnostic Program Gauge (DPG) features a backlit LCD display with three push buttons all in a compact 2 inch gauge. The LCD is clearly readable in both bright sunlight as well as total darkness. The DPG provides a complete user interface for other Function Enhancement Packs and allows each system to be field configured to suit the customer's unique requirements. After configuring, the DPG can be removed in cost-sensitive applications.

Some of the EP250 configurable features include:

- Automatic preheat duration
- Afterglow duration
- Failure indication with shutdown or indication only
- Over-speed shutdown
- Normally open or normally closed shutdown switches

All standard panels include feature a 12 inch wiring harness terminating into a sealed weather proof plug. This robust universal wiring connection performs well in harsh environments and allows interchanging a number of different panels and harnesses. This design allows for simplified installation as well as a flexible means to incorporate custom plug-and-play engine wiring harnesses and standard harness extension

Note

The engine harness is not included with the panel.

A number of standard engine harnesses are available or
LOFA can develop a custom harness for you exact needs.

Generic harnesses in various lengths are available for field customization.

Warning

When replacement parts are required, LOFA Industries recommends using replacement parts supplied by LOFA or parts with equivalent specifications.

Failure to heed this warning can lead to premature failure, product damage, personal injury or death.

Important Safety Information

The warnings in this publication are not all inclusive.

LOFA Industries cannot anticipate every potential hazard.

Appropriate safety rules and precautions should be followed with any tool, work method or operating procedure.

Improper procedures, tools and materials may cause damage or make the equipment unsafe to operate.

Only persons with appropriate training, skills and tools should perform these functions.

Improper operation, maintenance or repair of this product can be dangerous and may result in injury or death.

Do not operate or perform any maintenance or repair on this product until all operation, maintenance and repair information is read and understood.

The information, specifications, and illustrations in this publication are based on information available at the time of publication.

All items are subject to change at any time without notice.

Operation

Turning the control system key to the run position starts a self-test which causes all LEDs to illuminate once, activates the alarm output for one second and enables the fuel run/stop solenoid output. After self-test, the LEDs indicate the state of the inputs they monitor. The normal indications are battery charge and oil pressure on most applications. If these LEDs are not illuminated at this time it may indicate the inputs are not properly connected.

The Preheat LED is illuminated when the key switch is turned to the run position if automatic preheat is configured or if an external preheat control is connected (See Preheat Options). Preheat time varies from application to application. After waiting for the Preheat LED to extinguish, the engine is cranked by turning and holding the key switch in the start position until the engine starts. The key switch is spring loaded to return automatically to the run position when released. The Preheat LED is illuminated during afterglow if enabled.

Note

The key switch is equipped with a mechanical start locking device.
An attempt to re-crank the engine can only be made by turning the key switch to the off position to reset the start locking mechanism.

If the engine is not started within 10 seconds of turning on the system, the fuel run/stop solenoid output is turned off to prevent battery discharge when the key switch is left in the run position. The fuel run/stop solenoid output is turned off after 10 seconds even if preheating. As soon as the key switch is turned to the start position the solenoid output is enabled. The afterglow cycle begins when the key switch returns to the run position.

Note

If conditions do not warrant preheat, the engine may be started by turning the key to the start position without waiting for the preheat time to expire.

Control system instrument power, including the hourmeter and voltmeter, is provided by the fuel run/stop solenoid output. If the instruments do not power up when the key is turned to the run position, this indicates a problem with the solenoid circuit (see Troubleshooting).

After the engine starts, the control system electronics ignore all shutdown conditions for the first 10 seconds. This delay eliminates the requirement to hold a by-pass override button during starting and allows the system conditions such as oil pressure to normalize. The 10 second timer starts when the key switch returns to the run position.

Note

Starter input is required for correct system operation. If the starter motor input is not activated (connected to battery positive) and the engine is started through another means (i.e. air starter) the engine will shutdown 10 seconds after the key switch is turned to the run position.

To prevent unintentional engine shutdowns caused by intermittent conditions (i.e., pressure spikes, coolant movement) the control system requires a constant 1 second fault input to cause engine shutdown.

Warning

When used in combination with mechanical float type switches
engine vibrations may prevent constant contact closure.
The control system can be configured to shutdown with no delay.

See the *EP250 Configuration Guide* for detailed preheat control instructions.

The control system has the ability to shut down the engine for over speed. Over speed will be indicated via a blinking *Battery Charge* LED. If the control system is equipped with the DPG, the display will also indicate over speed shutdown. The control system senses RPM either by the frequency terminal of the alternator, proximity switch or magnetic pick-up.

Preheat Options

Preheat Output

Preheat is a 1A output for control of an external power relay with predetermined preheat and afterglow times. A relay should be selected with appropriate amperage capacity for the installed cold starting aid (glowplug, intake air heater, etc.). Applications using multiple cold starting aids may require multiple relays. Optional or additional components may allow preheat time to be modified by sensing ambient temperature. Depending on specific configuration, this output may provide either high side (battery positive) or low side (ground) control.

Note

Consult engine documentation when selecting cold starting aid,
power relay and heating specifications.

Preheat Indication Input

With this option, the preheat LED provides indication for an external preheat control system. Depending on specific controls and configuration, this input can be configured to accept either high side (battery positive) or low side (ground) control.

Indicators

Battery LED (Red)

A solidly illuminated Battery LED indicates a battery charge failure. A battery charge failure may be caused by a faulty alternator, broken drive belt or the alternator not excited. A battery voltage reading of approximately 14 volts on a 12 volt system (28 volts on a 24 volt system) while the engine is running indicates the battery is charging properly. Irregular blinking of the Battery LED may indicate a failing charge circuit. The system can be configured for battery charge failure to indicate only.

Overspeed Indication

A regularly blinking Battery LED indicates the configured overspeed RPM has been exceeded. The overspeed RPM can be verified, changed or disabled (see the *EP250 Configuration Manual* for details).

Oil Pressure LED (Red)

A solidly illuminated Oil Pressure LED indicates low oil pressure failure. The control system typically senses low oil pressure from a ground contact switch on the engine. When a sender/switch combination is used on the engine, the marking *WK* generally indicates the switch terminal. This input typically expects a normally closed switch (ground contact when oil pressure is low). A defective switch or shorting the shutdown input to ground can cause low pressure fault indication. Additionally, when using sender/switch combinations, swapping the *WK* and *G* terminal can cause unintended shutdowns. The system can be configured for oil pressure failure to indicate only.

Warning

Low oil pressure is not an indication of low oil level.

For best possible protection LOFA recommends using
our solid-state oil level shutdown switch.

Note

Most shutdown switches are grounded through the switch body.
Do not use insulating sealant (i.e. Teflon tape) when installing switches.

Temperature LED (Red)

A solidly illuminated Temperature LED indicates high engine temperature failure. The control system typically senses high temperature from a ground contact switch on the engine. When a sender/switch combination is used on the engine, the marking *WK* or *W* generally indicates the switch terminal. This input typically expects a normally open switch (ground contact when engine temperature is too high). A defective switch or shorting the shutdown input to ground can cause over temperature fault indication. Additionally, when using sender/switch combinations, swapping the *WK* or *W* and *G* terminal can cause unintended shutdowns. The system can be configured for temperature failure to indicate only.

Warning

If the temperature switch is not in contact with coolant due to
coolant loss the engine is not protected from overheating.

For best possible protection, LOFA recommends using
our solid-state coolant level shutdown switch.

Note

Most shutdown switches are grounded through the switch body.
Do not use insulating sealant (i.e. Teflon tape) when installing switches.

Some thermostat housings are composites and do not provide ground for the switch.

AUX 1 *AUX 1 LED (Red)*

A solidly illuminated AUX 1 LED indicates auxiliary 1 failure (i.e., coolant level, oil level, belt breakage, hydraulic pressure, etc.). The control system typically senses failure using a ground contact switch. Auxiliary inputs are equipment specific and determined by the equipment manufacturer. A defective switch or shorting

the shutdown input to ground can cause fault indications. The system can be configured for auxilary 1 failure to indicate only.

A blinking AUX 1 LED indicates SW input failure. The control system typically senses failure using a ground contact switch. The SW input is equipment specific and determined by the equipment manufacturer. A defective switch or shorting the shutdown input to ground can cause fault indications.

AUX 2 LED (Red)

A solidly illuminated AUX 2 LED indicates auxiliary 2 failure (i.e., air flow restriction, fuel level, etc.) but by default does not cause a shutdown. The control system typically senses failure using a ground contact switch. Auxiliary inputs are equipment specific and determined by the equipment manufacturer. A defective switch or shorting the shutdown input to ground can cause fault indications. The system can be configured for auxilary 2 failure to indicate only.

Preheat LED (Red)

A solidly illuminated Preheat LED is the system preheat indication. When the LED extinquishes the preheat period is complete and the engine may be cranked. The LED illuminates again to indicate afterglow.

Gauges

Voltmeter

The voltmeter is connected to the fuel run/stop solenoid output. If the voltmeter does not indicate in the run position, this indicates a problem with the solenoid circuit. A battery voltage reading of approximately 14 volts on a 12 volt system (28 volts on a 24 volt system) while the engine is running indicates the battery is charging properly.

Tachometer

The tachometer indicates engine RPM using a frequency signal derived from the engine. This signal may be provided by an alternator frequency tap, proximity switch. An optional amplifier/divider can be added for use with a magnetic pickup.

Note

If the alternator is not excited (not charging),
no frequency is generated and the tachometer will indicate 0 RPM.

The tachometer is factory calibrated to indicate correctly when the panel is preconfiguring or field calibrated with a Diagnostic Programming Gauge (DPG). The tachometer can be calibrated using standard procedures if the configuration is not performed (see *Tachometer Calibration Instuctions* for details).

Oil Pressure Gauge

The gauge measures oil pressure with a resistance sender on the engine referenced to ground. When a sender/switch combination is used on the engine, the marking *G* generally indicates the gauge terminal. The gauge expects a low resistnace for low pressure and a higher resitance for higher pressure. If the gauge is not connected to the sender, the gauge will read full scale (pegged). A defective sender or shorting the gauge input to ground will cause the gauge to read 0 pressure. When using sender/switch combinations, swapping the *WK* and *G* terminal prevents the gauge from working and may cause unintended shutdowns.

Warning

Low oil pressure is an indication of engine wear,
not an accurate indication of low oil level.

Note

Senders and gauges must be matched to indicate correctly.

Most senders are grounded through the sender body.
Do not use insulating sealant (i.e. Teflon tape) when installing senders.

Temperature Gauge

The gauge measures engine temperature with a resistance sender on the engine referenced to ground. When a sender/switch combination is used on the engine, the marking *G* generally indicates the gauge terminal. The gauge expects a high resistnace for low temperatures and a lower resitance for higher temperatures. If the gauge is not connected to the sender, the gauge will read 0. A defective sender or shorting the gauge input to ground will cause the gauge to read full scale (pegged). When using sender/switch combinations, swapping the *WK* and *G* terminal prevents the gauge from working and may cause unintended shutdowns.

Warning

If the temperature sensor is not in contact with coolant due to coolant loss
the gauge will not accurately indicate engine temperature.

Note

Senders and gauges must be matched to indicate correctly.

Most senders are grounded through the sender body.
Do not use insulating sealant (i.e. Teflon tape) when installing senders.

Some thermostat housings are composites and do not provide ground for the sender.

Hourmeter

The hourmeter is connected to the fuel run/stop solenoid output. If the hourmeter does not count in the run position, this may indicate a faulty hourmeter or a problem with the solenoid circuit. If the engine shutsdown or is not started within 10 second the hourmeter stops counting.

Additional Gauges

Additional gauges can be added by removing blind covers and installing the gauge. Power connections are provided with the standard configuration.

Harness

Sealed Connectors

The provided sealed weather proof plug includes a grey locking device which must be released to separate the connectors. Press the tab on the connector housing to release the connectors.

Warning

LOFA does not recommend using dielectric grease or sealant with sealed connectors. These chemicals may cause seal damage and allow water entry.

Use LOFA provided cavity plugs to seal the connector if wires are removed.

Unsealed Connectors

For unsealed connectors exposed to the elements, LOFA recommends using dielectric grease to protect contacts.

Warning

LOFA does not recommend using sealant with unsealed connectors. Sealant traps moisture in the connector and encourages corosion.

Harness Routing

The minimum routing of radius of the wiring harnesses should be at least two times the diameter of the wiring harness. Bends should be avoided within 1 inch (25 mm) of any connector in order to avoid seal distortion allowing moisture to enter the connector.

Note

For harness length in excess of 10 ft a relay must be added to the start solenoid circuit.

LOFA offers starter relay kits for mounting near the engine.

Battery Circuit Requirements

Battery Positive Connection

The electronic control system operates on either a 12 VDC or 24 VDC electrical systems. The unswitched battery positive connection to the control system is made at the weather proof connector. The control system provides switched positive battery protected by a 15 Amp fuse (12 V or 24 V system).

Protection for the unswitched battery positive circuit is dependent on specific equipment configuration. The overload protection should not exceed 125% of the sum of all output currents plus 5 Amps for the control system. Powering the control system through dedicated circuits with appropriate overload protection reduces the possibility of system damage.

Circuit breakers are preferred over in-line fuses for circuit protection. Over current protection devices should ideally be located in a central location. If automatic reset circuit breakers are used, consideration of the environment of the breaker is critical and may affect the trip point. The trip point of some circuit breakers can be significantly reduced below the rated trip point if the circuit breaker is exposed to high temperatures.

Warning

Disconnecting the battery while the engine is running
may damage electrical components.

When using a battery disconnect switch, LOFA recommends using a
2 pole switch to disconnect both the battery and alternator output.

Battery Negative Connection (Grounding)

Warning

Improper grounding can cause electrical noise, unreliable operation and may damage the control system or other components. All ground connections must be free from foreign materials, including paint, which may interfere with proper grounding.

A reliable ground must be provided for the control system.
LOFA recommends the ground connection be made directly to the battery negative.
Grounding through frame members is not recommended.

All ground paths must be capable of carrying any likely fault currents.

Do not reverse the battery polarity. Attempting to crank the engine when the polarity of the battery connections is reversed may damage the control system.

Note

A maximum of three ring terminals should be connected to a ground stud in order to ensure integrity of the ground connection. The use of more than three terminals can cause the connection to become loose.

Voltage Drop

If control system voltage drops below 6 volts for more than one tenth of a second, the control system may reset causing the self test to reactivate and the engine to shutdown after 10 seconds. Resetting the control

system is equivalent to quickly turning the key switch to off and back to run without starting the engine. Since the control system did not sense a start signal, the fuel run/stop solenoid deactivates after 10 seconds. Voltage drops can be caused by transients from external equipment, improper wire sizes, faulty wiring or nearby lightning strikes. In the absence of a *LOFA Power Box*, relays may be needed for long wire runs.

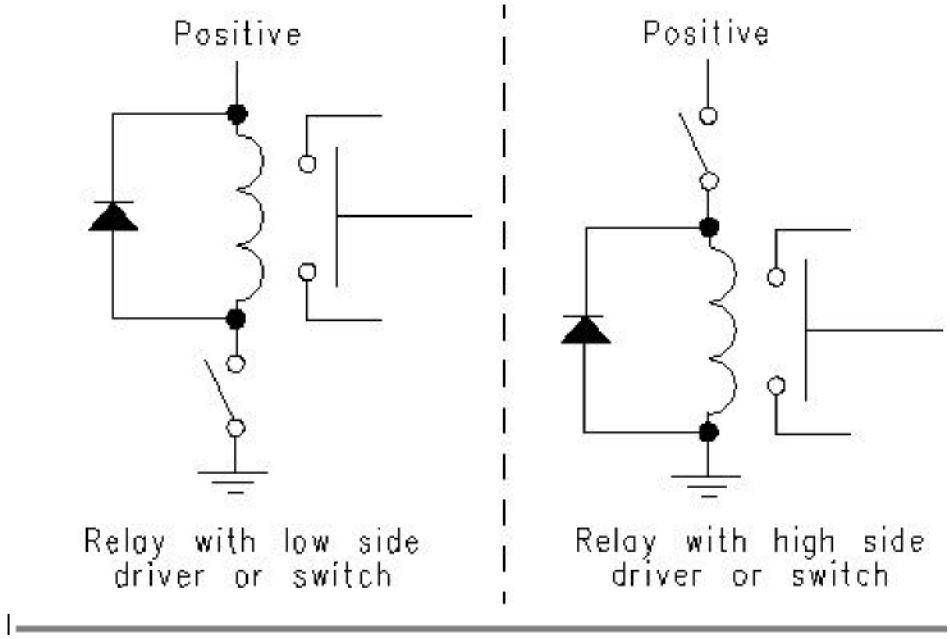
Suppression of Voltage Transients (Spikes)

Warning

The installation of voltage transient suppression at the transient source is required.

LOFA follows SAE recommended electrical environment practices.

Inductive devices such as relays, solenoids and motors generate voltage transients and noise in electrical circuits. Unsuppressed voltage transients can exceed SAE specifications and damage electronic controls.



Relays and solenoids with built-in voltage transient suppression diodes are recommended whenever possible. Refer to the illustration for proper installation of diodes when built-in voltage transient suppression is not available.

Locate inductive devices as far as possible from the components of the electronic control system. When using electric motors it may also be necessary to add isolation relays to eliminate voltage transients, noise and prevent back feed.

Note

LOFA harness assemblies typically include all required engine control suppression devices. Added equipment will require additional protection.

Welding on Equipment with Electronic Controls

Proper welding procedures are required to avoid damage to electronic controls, sensors, and associated components. The component should be removed for welding if possible.

The following procedure must be followed if the component must be welded while installed on equipment with electronic controls. This procedure will minimize the risk of component damage.

Warning

Do not ground the welder to electrical components such as the control ground or sensors. Improper grounding can cause damage to electrical components

Clamp the ground cable from the welder to the component being welded. Place the clamp as close as possible to the weld to reduce the possibility of damage.

1. Stop the engine. Turn the key switch to the OFF position.
2. Disconnect the negative battery cable from the battery.
3. Open any installed battery disconnect switch.
4. Unplug the control system if possible.
5. Connect the welding ground cable as close as possible to the area to be welded.
6. Protect the wiring harness from welding debris and spatter.
7. Use standard welding methods to weld the materials.

General Troubleshooting

For additional information, refer to engine manufacturer troubleshooting guide.

No response from starter motor

Possible Cause	Possible Remedy
No battery voltage to starter	Verify wiring and battery connection (power and ground)
Battery discharged	Charge or replace battery, verify alternator charging
Tripped overcurrent protection	Correct fault, replace or reset overcurrent protection
No signal from control system	No power to control system (see Control System Troubleshooting below)
Defective starter solenoid	Replace starter solenoid
Defective starter motor	Replace starter motor

Engine will crank but not start

Possible Cause	Possible Remedy
Engine not getting fuel	Check fuel level, filter, fuel pump, verify no air in fuel lines
Fuel run/stop solenoid not engaged	See Fuel Solenoid Run/Stop Troubleshooting (below)
Tripped overcurrent protection	Correct fault, replace or reset overcurrent protection
No preheat (cold condition)	See Preheat Troubleshooting

Engine runs for 10 seconds and shuts down

Possible Cause	Possible Remedy
Shutdown switch input active	Verify shutdown source exists, correct condition or correct faulty circuit
Battery not charging	Verify alternator charging (see Alternator not charging battery below)
Control board did not sense start signal	Engine started through alternate method (i.e., manual air start, push start, etc.)
Defective control system	See Control Panel Troubleshooting (below)

Engine runs longer than 10 seconds and shuts down

Possible Cause	Possible Remedy
Shutdown switch input active	Correct engine fault, verify shutdown switch wiring
Circuit overload protection tripped	Correct overload, keep control system from overheating (over 185° F/85° C)
Voltage transients (spikes)	Add suppressor diodes, protect from nearby lightening strikes, shield induced spikes from other equipment, add electric motor control relay
Defective control system	See Control System Troubleshooting (below)

Alternator not charging battery

Possible Cause	Possible Remedy
Broken or slipping alternator drive belt	Adjust or replace alternator drive belt
Alternator not excited	Verify excitation circuit connected, replace faulty regulator, add additional excitation resistor
Alternator output not connected	Install charge wire
Alternator not grounded	Clean or add ground connection
Alternator faulty	Replace faulty alternator

Fuel Run/Stop Solenoid Troubleshooting

Engine does not stop immediately

Possible Cause	Possible Remedy
Back feed from motor (i.e., cooling fan)	Add relay or blocking diode
Sticking solenoid linkage	Repair or replace solenoid linkage
Fuel valve without check valve	Install or repair check valve

Fuel run/stop solenoid does not engage

Possible Cause	Possible Remedy
No power to solenoid	Locate reason for lack of power and correct (Circuit overloaded? Failed suppressor diode? Faulty wiring?)
No power to solenoid pull coil	Correct faulty wiring, check pull control circuit (see Power Box Troubleshooting below)
Incorrect linkage adjustment	Adjust solenoid linkage
Faulty solenoid	Replace solenoid
Failed suppressor diode	Correct wiring (diode reversed?), replace suppressor diode
Optional e-stop engaged	Disengage e-stop

Engine not getting fuel

Possible Cause	Possible Remedy
Empty fuel tank	Fuel engine
Clogged filter	Replace filter
Air in fuel lines	Bleed fuel lines
Low fuel pressure	Replace faulty fuel pump and/or clogged filter
Faulty fuel pump	Replace fuel pump, correct wiring fault (electric fuel pump)

Preheat Troubleshooting

Engine is hard to start in cold conditions

Possible Cause	Possible Remedy
Start attempt before preheat complete	Wait for preheat time to elapse, crank as soon as time elapses
Incorrect preheat specification	Correct control system configuration, install correct control system
Heater faulty	Replace heater
Heater relay faulty	Replace relay
Preheat control not functioning	Correct wiring, correct control system configuration
Faulty control system	See Control System Troubleshooting (below)

Engine produces excessive white smoke after starting

Possible Cause	Possible Remedy
Afterglow not enabled	Reconfigure control system
Heater faulty	Replace heater
Heater relay faulty	Replace relay
Preheat control not functioning	Correct wiring, correct control system configuration
Faulty control system	See Control System Troubleshooting (below)

Control System Troubleshooting

Control system does not perform self test

Possible Cause	Possible Remedy
Tripped overcurrent protection	Correct fault, replace or reset overcurrent protection
Faulty connection to battery	Correct battery connections (see Battery Circuit Requirements above)

Control system performs normal self test, engine cranks, runs and shuts down

Possible Cause	Possible Remedy
Only Battery LED illuminated	Correct battery charge failure (see Battery not charging above)
Only Oil Pressure LED Illuminated	Correct low oil pressure condition or faulty switch, correct wiring fault
Only Temperature LED Illuminated	Correct overheating condition or faulty switch, correct wiring fault
Only Aux LED Illuminated	Correct fault condition (i.e. v-belt, coolant level) or faulty switch, correct wiring fault
All normally closed shutdowns illuminate for one second (control system reset)	Add suppressor diodes, protect from nearby lightening strikes, shield induced spikes from other equipment, add electric motor control relay

Testing Shutdown Inputs

Shutdown switches signal a fault by ground contact in most systems. Shutdown operation can be verified by grounding the shutdown inputs individually. It may be necessary to remove the wire from the shutdown switch to perform this test.

Note

Most shutdown switches are grounded through the switch body.
Do not use insulating sealant (i.e. Teflon tape) when installing switches.

Some thermostat housings are composites and do not provide ground for the switch.

Revision History

Initial Release.

Rev A – 22-May-2006. Corrected typographical errors.

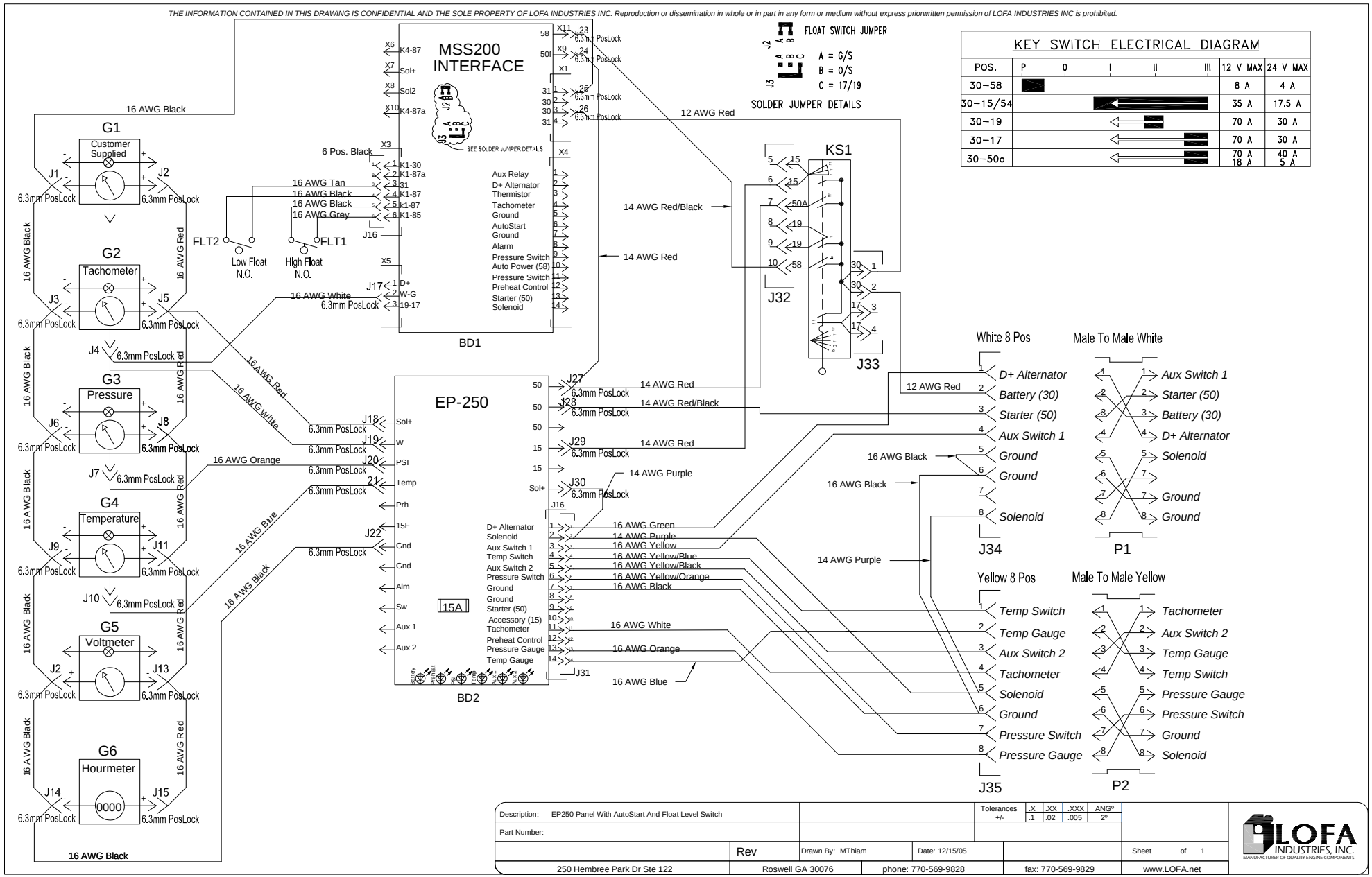
Rev B – 26-Oct-2006. Add symbols to *Indicators*, corrected typographical errors.

Rev C – 8-Jan-2007. Updated schematics, removed Power Box information.

Rev C.1 – 28-Feb-2007. Added part numbers.

Typical Schematics

The following pages show typical schematics.
Details vary from installation to installation.
See the specific schematics for installation for details.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MSS200 INTERFACE
EP-250
BD1
BD2
FLOAT SWITCH JUMPER
A = G/S
B = O/S
C = 17/19
SOLDER JUMPER DETAILS
KEY SWITCH ELECTRICAL DIAGRAM
POS. P 0 I II III 12 V MAX 24 V MAX
30–58 8 A 4 A
30–15/54 35 A 17.5 A
30–19 70 A 30 A
30–17 70 A 30 A
30–50a 70 A 18 A 40 A 5 A
G1 Customer Supplied
G2 Tachometer
G3 Pressure
G4 Temperature
G5 Voltmeter
G6 Hourmeter
KS1
J32
J33
J34
J35
P1
P2
White 8 Pos
Male To Male White
Yellow 8 Pos
Male To Male Yellow
Low Float N.O.
High Float N.O.
FLT1
FLT2
15A
16 AWG Black
16 AWG Red
16 AWG White
16 AWG Orange
16 AWG Blue
16 AWG Tan
16 AWG Grey
14 AWG Red
14 AWG Red/Black
14 AWG Purple
12 AWG Red
6.3mm PosLock
Description: EP250 Panel With AutoStart And Float Level Switch
Part Number:
Rev
Drawn By: MThiam
Date: 12/15/05
Sheet of 1
Tolerances +/- .X .1 .XX .02 .XXX .005 ANGº 2º
250 Hembree Park Dr Ste 122
Roswell GA 30076
phone: 770-569-9828
fax: 770-569-9829
www.LOFA.net
LOFA INDUSTRIES, INC.
MANUFACTURER OF QUALITY ENGINE COMPONENTS

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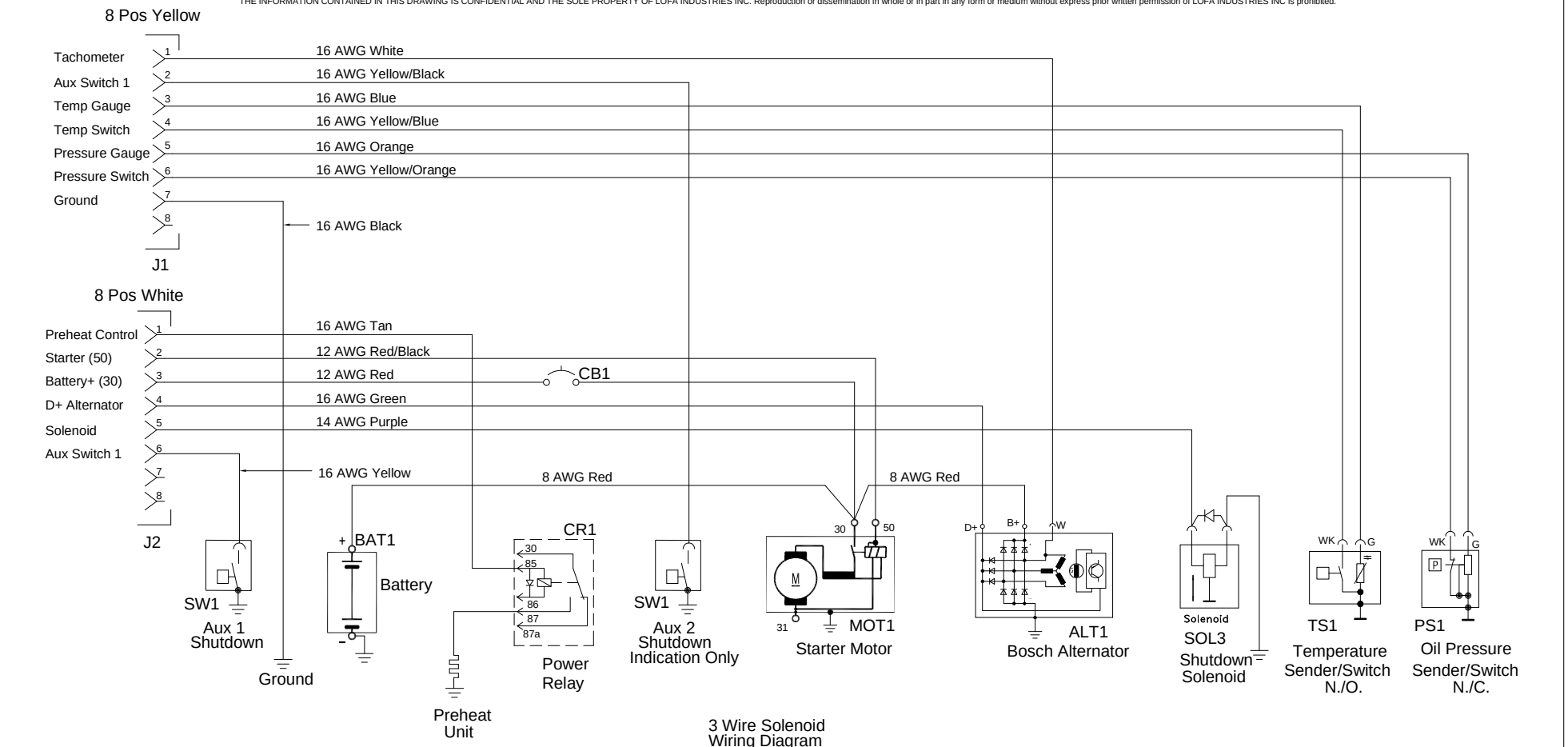

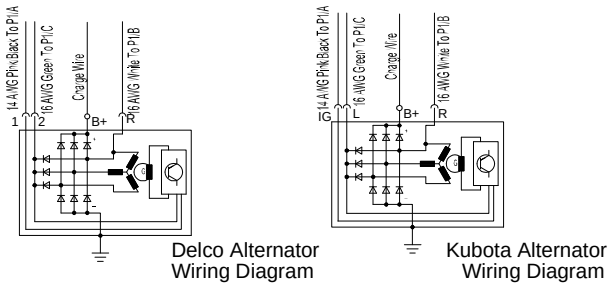

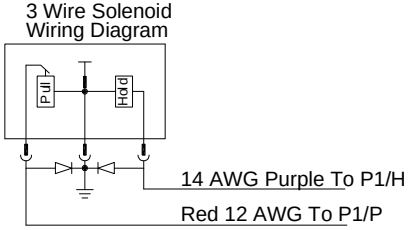

Description: MC-536 Generic Engine Schematic W/ Yellow And White Connectors			Tolerances +/-	.X .1 / XX .02 / .XXX .005 / ANG° 2°	
Part Number:					
	Rev	Drawn By: MThiam	Date:		Sheet 1 of 1
250 Hembree Park Dr Ste 122	Roswell GA 30076	phone: 770-569-9828	fax: 770-569-9829		www.LOFA.net

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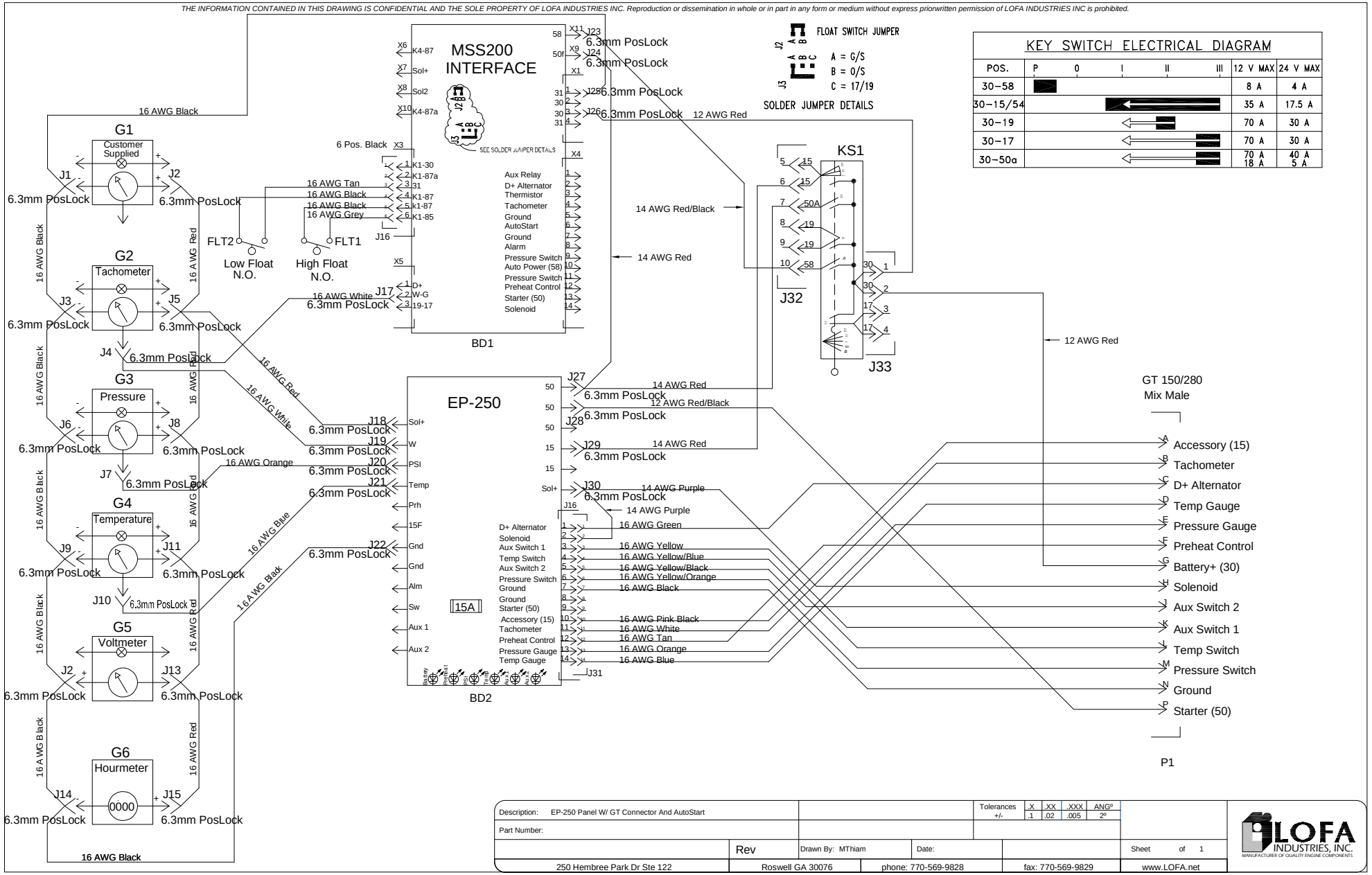
MANUFACTURER OF QUALITY ENGINE COMPONENTS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70 A
30 A
30-17
70 A
30 A
30-50a
70 A 18 A
40 A 5 A
KS1
J32
J33
G1
Customer Supplied
G2
Tachometer
G3
Pressure
G4
Temperature
G5
Voltmeter
G6
Hourmeter
Low Float N.O.
High Float N.O.
FLT1
FLT2
GT 150/280 Mix Male
P1
Accessory (15)
Tachometer
D+ Alternator
Temp Gauge
Pressure Gauge
Preheat Control
Battery+ (30)
Solenoid
Aux Switch 2
Aux Switch 1
Temp Switch
Pressure Switch
Ground
Starter (50)
16 AWG Black
12 AWG Red
14 AWG Red
14 AWG Red/Black
16 AWG Red
16 AWG White
16 AWG Orange
16 AWG Blue
14 AWG Purple
16 AWG Green
16 AWG Yellow
16 AWG Yellow/Blue
16 AWG Yellow/Black
16 AWG Yellow/Orange
16 AWG Pink Black
16 AWG Tan
6.3mm PosLock
Description: EP-250 Panel W/ GT Connector And AutoStart
Part Number:
Rev
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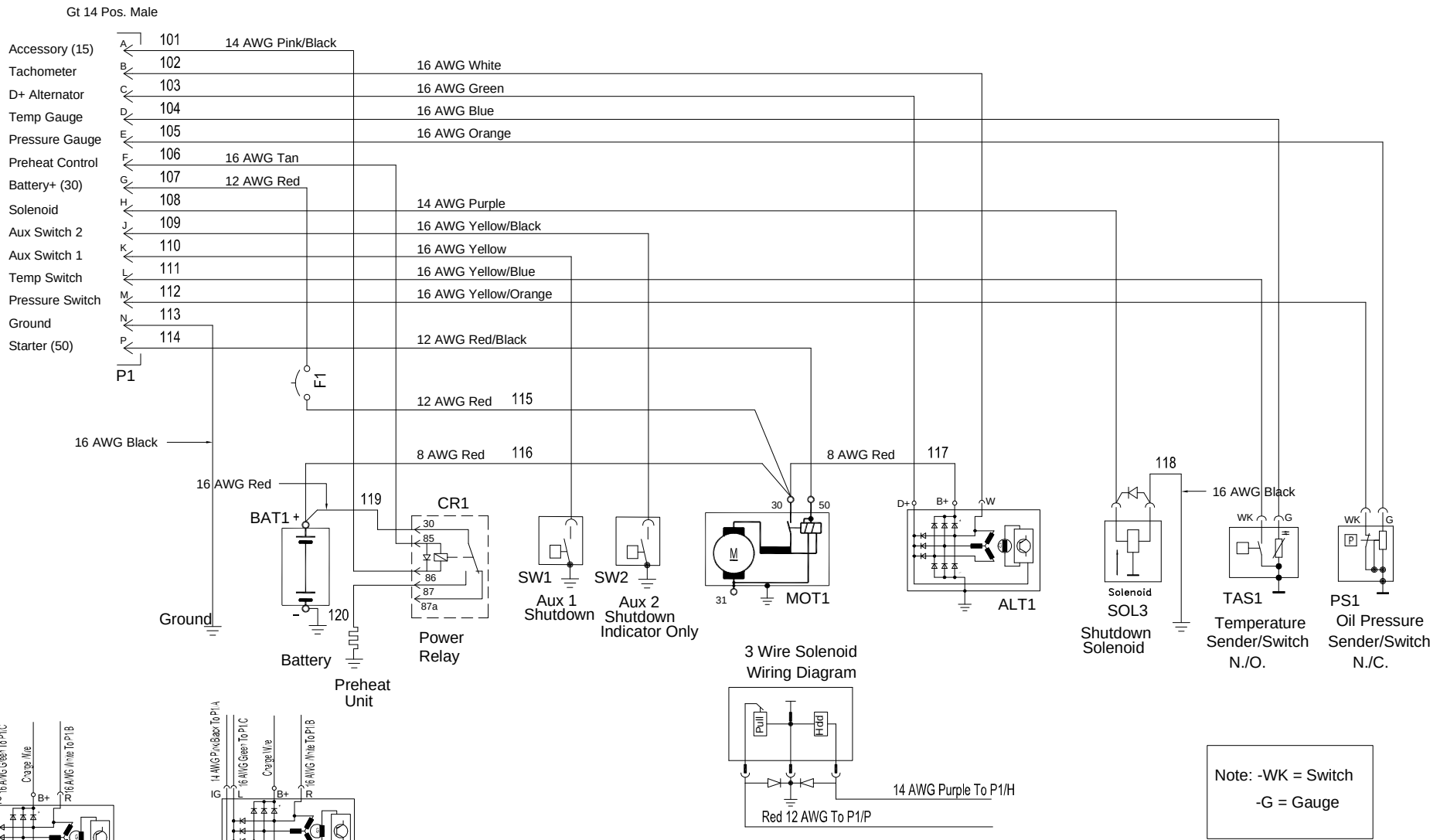


Description: MC-536 Engine Generic Diagram With GT Male			Tolerances +/-	.X .1 / .XX .02 / .XXX .005 / ANG° 2°	
Part Number:					
	Rev	Drawn By: MThiam	Date:		Sheet 1 of 1
250 Hembree Park Dr Ste 122	Roswell GA 30076	phone: 770-569-9828	fax: 770-569-9829	www.LOFA.net	

LOFA INDUSTRIES, INC. MANUFACTURER OF QUALITY ENGINE COMPONENTS

HYDRO-THROTTLE CONTROL

INSTALLATION INSTRUCTIONS

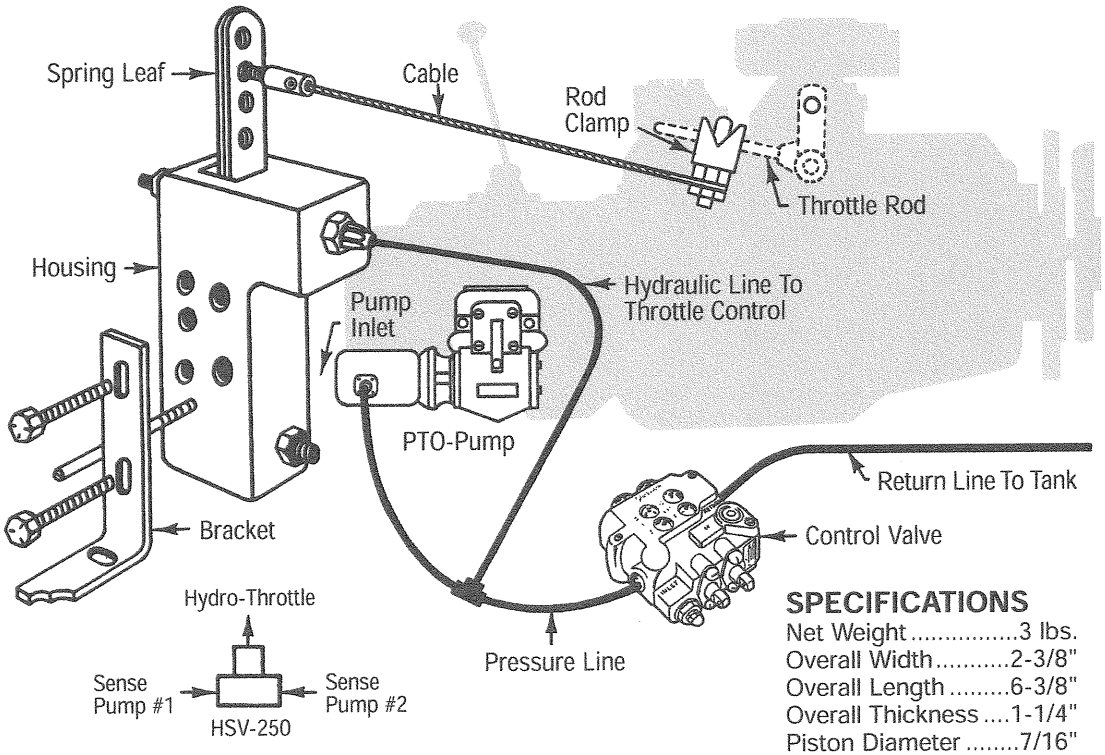
DESCRIPTION

Muncie's STA-9020 Hydro-Throttle Control, used in conjunction with hydraulic powered equipment, will automatically advance engine speed to a pre-selected R.P.M.

The STA-9020 Hydro-Throttle Control is connected into the hydraulic pressure line between the pump and control valve. Activation of any spool of the control valve will cause a pressure build-up in the pressure sensing part of the STA-9020. The internal piston, moving against the leaf springs, causes the springs to pull the throttle linkage to advance the engine speed.

When the control valve is de-activated, pressure drops and allows the STA-9020 to release its pull against the throttle linkage, returning the engine speed to idle. Note: For use on tandem pumps, incorporate Muncie's HSV-250 shuttle valve to isolate two circuits.

Note: For use on tandem pumps, incorporate Muncie's HSV-250 shuttle valve to isolate two circuits.



SPECIFICATIONS

Net Weight.....3 lbs.
Overall Width.....2-3/8"
Overall Length.....6-3/8"
Overall Thickness....1-1/4"
Piston Diameter.....7/16"
Port Size.....3/8 O.D.T.

FULLY ADJUSTABLE

The Muncie STA-9020 Hydro-Throttle is fully adjustable to meet a wide variance of operating conditions and system requirements.

The **spring rate** is adjustable by moving the fulcrum screw (5) and changing the number of leaf springs (three are furnished).

Spring tension is adjustable by changing the adjusting screw (4) at the base of the casting.

The **amount of travel** of the accelerator rod is adjustable by changing the activating rod (9) from spring hold 4 through 1 and by changing the amount of cable slack at engine idle.

The Hydro-Throttle was shipped to you assembled in a medium configuration. The table below indicates five variations of settings. Your unit is set up for variation 2. Try this variation first unless prior installations have indicated another set up is best for your application.

ADJUSTMENT TABLE

Variation Number	No. of Springs	Fulcrum Hole	Spring Tension *Turns	Spring Tension *Pressure	Spring Tension Rate	Actuating Rod Hole Location
1	3	A	3	1100	11X	4
2	3	B	3	780	3X	4
3	3	C	2-1/2	640	Normal	4
4	2	C	2	370	3/4X	4
5	2	D	5/8	300	1/4X	4

***Note:** Apply turns from when the screw (4) just begins to deflect the spring at zero load. Pressure is approximate when piston will begin to move.

INSTALLATION INSTRUCTIONS

1. Attach the "L" shaped mounting bracket to the control (1).
2. Mount the bracket to the engine so that the cable will be in line with the accelerator rod. Modify or bend the mounting bracket if necessary.
3. Attach the cable (10) and actuating rod assembly (9) to hole 4 of the leaf spring.
4. Mount the clamp (11) to the throttle rod and attach cable eyelet to one of the clamp studs.
5. Install a tee in the hydraulic line between the pump and control valve. This tee should be as close as possible to the valve.
6. Connect a 1/4" (minimum) high pressure hose between the tee and the pressure sensing port of the Hydro-Throttle control. Use a small amount of sealer on male threads only. DO NOT USE TEFLON TAPE. Do not allow any sealer to enter the piston area of the throttle control.

   YOU ARE NOW READY TO ADJUST THE HYDRO-THROTTLE.

ADJUSTMENT PROCEDURE

1. Start engine and engage PTO and pump, but do not energize any control valves yet. Allow system to warm up and run at idle without choke (slow idle).
2. Air bleed the pressure line by cracking the fitting at the Hydro-Throttle control.

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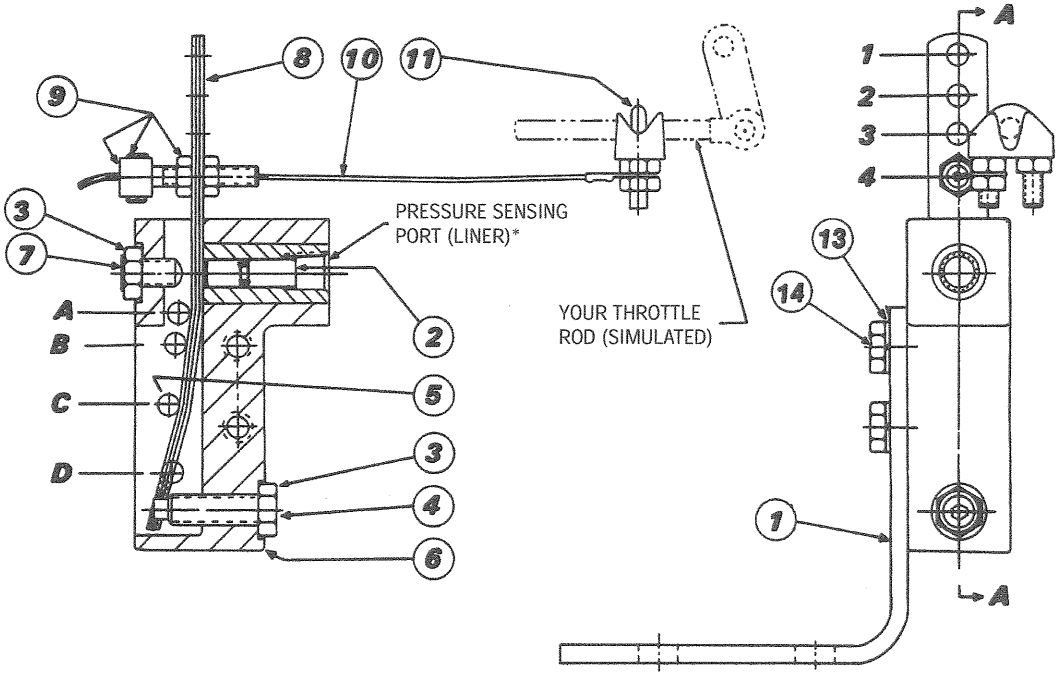
3. Turn speed adjusting screw (7) in until it touches spring. Then turn out one turn temporarily to limit stroke and prevent engine overspeeding.
4. Activate a highly loaded valve circuit. (Bottom out a cylinder to trip the pressure relief valve.) The Hydro-Throttle will attempt to pull accelerator rod.
5. Turn speed adjusting screw (7) outward until the desired engine speed (under load) is reached. Tighten lock nut (3).
6. Return valve to neutral position. The Hydro-Throttle will allow the engine to return to idle. If not, see Trouble Shooting Guide for probable causes.
7. Determine which hydraulic circuit produces the lowest pressure. (Lowering outriggers, boom swing, etc.) Operate this circuit and see if Hydro-Throttle will pull accelerator rod. If not, see Trouble Shooting Guide for probable cause.



STA-9020 PARTS LIST

ITEM	QTY	PART NO.	DESCRIPTION
1	1	28T35118	Bracket
2	1	47TA3790	Piston Assembly
3	1	22T35145	Nut, Jam 3/8-16
4	1	19T35127	Screw 3/8-16 x 2.00 Spring Tension Adjusting
5	1	19T35133	Screw, Fulcrum
6	1	01T35641	Housing (for Screw-In Liner)
7	1	19T35141	Screw 3/8-16 x 1.00 Speed Adjusting
8	3	27T35130	Spring, Leaf
9	1	47TA3796	Rod, Actuating, with Nuts and Set Screws
10	1	47TA3794	Cable Assembly
11	1	47TA3795	Clamp
12	1	47TA3792	Rod/Cable/Clamp Assembly
13	2	21T35143	Lockwasher
14	2	19T35144	Capscrew 5/16-24 x .75 Grade 5
NS*	1	28T35648	Screw-In Liner

TROUBLE SHOOTING HINTS

A. Problem: Engine Does Not Idle But Speeds Up When PTO Is Engaged

Probable Cause	*Remedy*
1. Control lever stuck open.	1. Return all valves to neutral.
2. Low leaf spring tension.	2. Repeat calibration.
3. Cold oil.	3. Warm oil.

B. Problem: Engine Does Not Speed Up When Light Load Is Applied

Probable Cause	*Remedy*
1. PTO not engaged.	1. Engage PTO.
2. Air in sensing line.	2. Bleed line. Crack fitting at control.
3. Connecting cable.	3. Reduce slack to minimum.
4. Stops on speed screw.	4. Adjust screw.
5. Hot oil.	5. Allow oil to cool.
6. Your engine throttle linkage.	6. Oil & repair. Check manufacturer for lighter spring if it's excessive.
7. Circuit pressure is too low.	7. Revise plumbing to increase spread between your circuit and by-passing pressures.
8. Excessive leaf spring tension.	8. Repeat calibration.
9. Excessive leaf spring rate.	9. Reduce spring rate. See adjustment table.

C. Problem: Engine Does Not Return To Idle After A Load Is Applied

Probable Cause	*Remedy*
1. Engine speed excessive.	1. Reset speed screw adjustment.
2. Your engine.	2. Make sure it can idle.
3. Connecting cable.	3. Check for slack.
4. Low leaf spring rate.	4. Increase spring rate. See adjustment table.
5. Low leaf spring rate.	5. Repeat calibration.
6. Excessive by-passing pressure.	6. Remove "bottlenecks" or increase line size downstream of the control connection.

WARNING: The Muncie Hydro-Throttle is only to be operated when the vehicle is stationary and the parking brake is set. The installer is responsible for providing a lockout system which makes the Hydro-Throttle inoperable if the parking brake is not set and the transmission is not in neutral.

ISO 9001
DNV
DNV Certification, Inc.
REGISTERED FIRM

MUNCIE Muncie® Power Products

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Drive Products, Inc., Toronto, Exclusive Agents for Canada

IN81-10 (Rev. 11-01) Printed in the U.S.A.

Performance data shown are the average results based on series of tests of production units and not necessarily representative of any one unit. Tests were run with oil viscosity 150 SUS at 100°F

MH25/50/51 PUMP PERFORMANCE DATA

Speed RPM		1" G.W.	1 1/4" G.W.	1 1/2" G.W.	1 3/4" G.W.	2" G.W.	2 1/4" G.W.	2 1/2" G.W.
900	GPM	8.5	10.5	13	15	17.5	20	22
	LPM	32	39.5	49	57	66	75.5	83.5
1200	GPM	12	15	18	21	24	27	30
	LPM	46.5	57	68	79.5	91	102	114
1500	GPM	15	19	23	27	31	35	39
	LPM	57	72	87	102	117	132	146
1800	GPM	18	23	27.5	32.5	37.5	42	47
	LPM	68	87	104	123	142	159	178
2100	GPM	21.5	27	32.5	38.5	44	48.5	55
	LPM	81.5	102	123	146	167	187	208
2400	GPM	25	31	37	44	51	57	63.5
	LPM	94.5	117	140	167	193	216	240

MH25/50 MOTOR PERFORMANCE DATA

	1" G.W.		1 1/2" G.W.		2" G.W.		2 1/2" G.W.	
	2000 psi	140 bar	2000 psi	140 bar	2000 psi	140 bar	2000 psi	140 bar
Speed RPM	A	B	A	B	A	B	A	B
800	10.5	670	15.5	1070	21	1450	26	1850
	39.5	7.5	58.5	12.5	79.5	16.5	98.5	21.5
1200	15.5	680	22.5	1075	30.5	1450	37.5	1840
	58.5	8	85	12.5	115	16.5	142	21
1600	20	670	30	1045	40	1440	49.5	1750
	75.5	7.5	114	12	151	16.5	187	20
2000	25	660	37	1030	49	1415	61.5	1720
	94.5	7.5	140	12	185	16.5	233	20

MH51 MOTOR PERFORMANCE DATA

	1" G.W.		1 1/2" G.W.		2" G.W.		2 1/2" G.W.	
	2500 PS1	175 bar	2500 PSI	175 bar	2500 PSI	175 bar	2250 PSI	175 bar
Speed RPM	A	B	A	B	A	B	A	B
800	10.5	825	15.5	1310	21	1810	26	2330
	39.5	9.5	58.5	15	79.5	21	98.5	27
1200	15.5	850	22.5	1340	30.5	1830	37.5	2340
	58.5	10	85	15.5	115	21	142	27
1600	20	830	30	1330	40	1805	49.5	2300
	75.5	9.5	114	15.5	151	21	187	26.5
2000	25	800	37	1290	49	1770	61.5	2250
	94.5	9	140	15	185	20.5	233	26

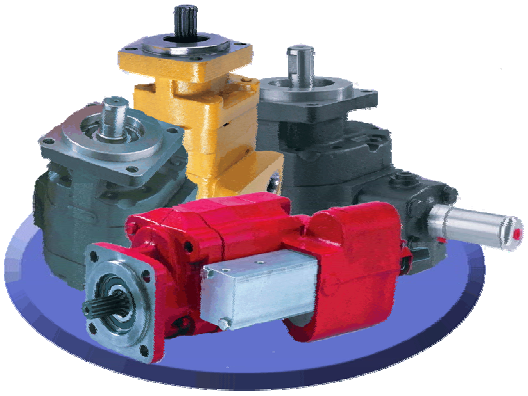
MH50/51 PL CHART		
Shaft Style	**Integral**	**Two Piece**
SAE "**BB**" Spline	9,900	8,000
SAE "**BB**" Key	6,600	6,600
SAE "**B**" Spline	6,400	6,400
SAE "**B**" Key	5,750	5,750
SAE "**C**" Spline	13,850	8,000
SAE "**C**" Key	13,000	8,000
Connecting Shaft		8,000

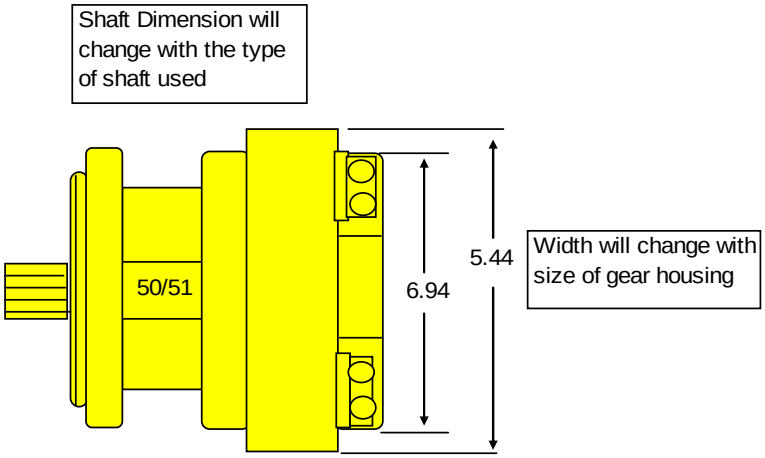
A: Input Flow GPM / LPM

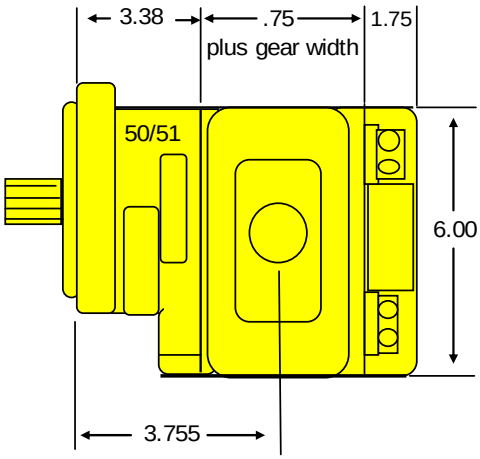
B: Output Torque IN / lbs Nm

GW: Gear Width

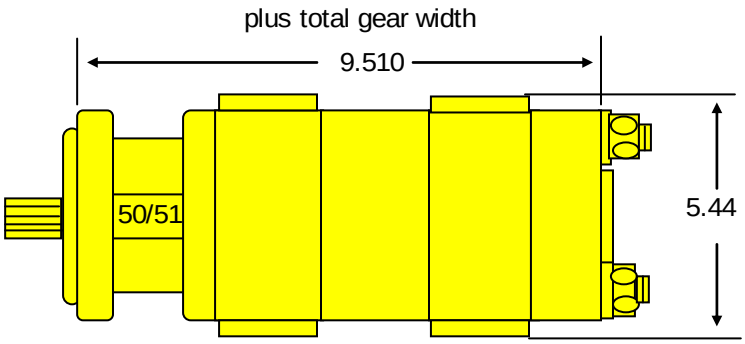
MH50 SERIES SINGLE UNIT

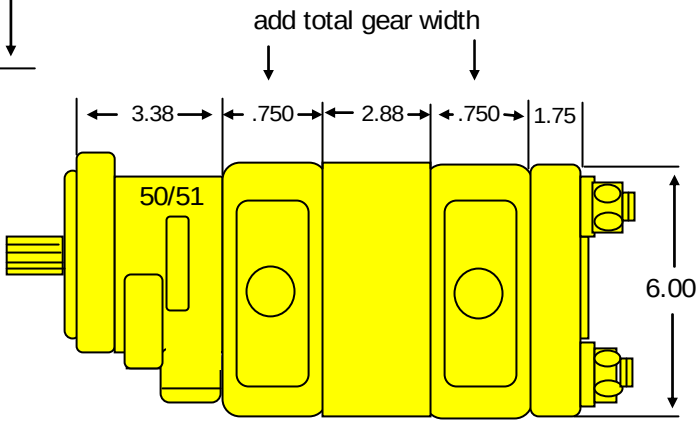






MH50 SERIES MULTIPLE UNIT



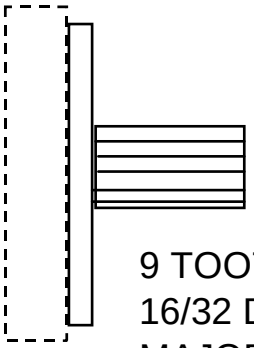


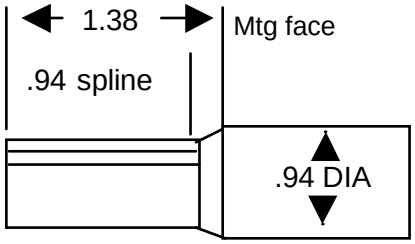
All dimensions in inches. Unfinished casting dimensions may vary

DRIVE SHAFT DIMENSIONS

Shaft extension may change according to models

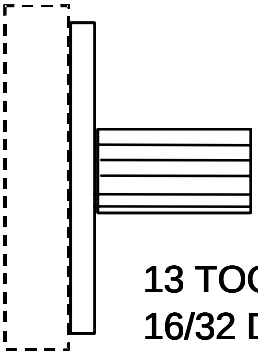
SAE A ANSI 16-4

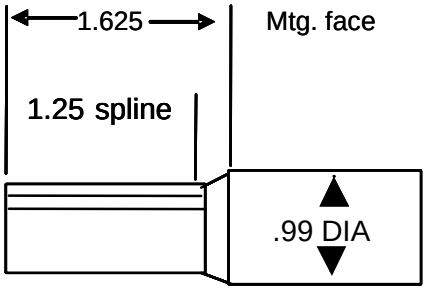




9 TOOTH SPLINE
16/32 DIAMETRAL PITCH
MAJOR DIA. .603 .609
MINOR DIA. .4835 MAX.

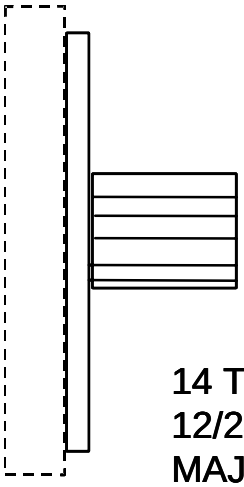
SAE B ANSI 22-4

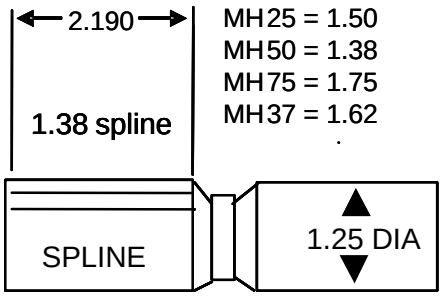




13 TOOTH SPLINE
16/32 DIAMETRAL PITCH
MAJOR DIA. .853-.858
MINOR DIA. .7335 MAX.

SAE C ANSI 32-4





14 TOOTH SPLINE
12/24 DIAMETRAL PITCH
MAJOR DIA. 1.223-1.228
MINOR DIA. 1.0627 MAX.

BEARING SERIES PRESSURE AND DISPLACEMENT

MH20	Gear size	In.^{3}/rev	cm.^{3}/rev	Max Pressure	
.05	1/2"	.99	16.1	3000 psi	207 bar
.07	3/4"	1.48	24.2	3000 psi	207 bar
1.	1"	1.97	32.3	3000 psi	207 bar
1.25	1 1/4"	2.46	40.4	3000 psi	207 bar
1.50	1 1/2"	2.96	48.4	3000 psi	207 bar
1.75	1 3/4"	3.45	56.5	2500 psi	172 bar
2.	2"	3.94	64.6	2500 psi	172 bar

MH30/31	Gear size	In.^{3}/rev	cm.^{3}/rev	Max Pressure		Max Pressure dowelled	
.05	1/2"	.99	16.1	2500 psi	172 bar	3000 psi	207 bar
.07	3/4"	1.48	24.2	2500 psi	172 bar	3000 psi	207 bar
1.	1"	1.97	32.3	2500 psi	172 bar	3000 psi	207 bar
1.25	1 1/4"	2.46	40.4	2500 psi	172 bar	3000 psi	207 bar
1.50	1 1/2"	2.96	48.4	2500 psi	172 bar	3000 psi	207 bar
1.75	1 3/4"	3.45	56.5	2250 psi	145 bar	2500 psi	172 bar
2.	2"	3.94	64.6	2250 psi	145 bar	2500 psi	172 bar

MH50/51	Gear size	In.^{3}/rev	cm.^{3}/rev	Max Pressure		Max Pressure dowelled	
.05	1/2"	1.28	20.9	2500 psi	172 bar	3000 psi	207 bar
.07	3/4"	1.91	31.3	2500 psi	172 bar	3000 psi	207 bar
1.	1"	2.55	41.8	2500 psi	172 bar	3000 psi	207 bar
1.25	1 1/4"	3.19	52.2	2500 psi	172 bar	3000 psi	207 bar
1.50	1 1/2"	3.83	62.7	2500 psi	172 bar	3000 psi	207 bar
1.75	1 3/4"	4.46	73.1	2000 psi	145 bar	3000 psi	207 bar
2.	2"	5.10	83.6	2000 psi	145 bar	2500 psi	172 bar
2.25	2 1/4"	5.74	94.0	2000 psi	145 bar	2500 psi	172 bar
2.5	2 1/2"	6.38	104.5	2000 psi	145 bar	2500 psi	172 bar

MH75/76	Gear size	In.^{3}/rev	cm.^{3}/rev	Max Pressure		Max Pressure dowelled	
.07	3/4"	3.07	50.28	2500 psi	172 bar	3000 psi	207 bar
1.	1"	4.1	67.15	2500 psi	172 bar	3000 psi	207 bar
1.25	1 1/4"	5.12	83.85	2500 psi	172 bar	3000 psi	207 bar
1.50	1 1/2"	6.15	100.7	2500 psi	172 bar	3000 psi	207 bar
1.75	1 3/4"	7.17	117.45	2500 psi	172 bar	3000 psi	207 bar
2.	2"	8.2	134.3	2500 psi	172 bar	2500 psi	172 bar
2.25	2 1/4"	9.22	151	2250 psi	155 bar	2500 psi	172 bar
2.5	2 1/2"	10.25	167.8	2250psi	155 bar	2500psi	172 bar
2.75	2 3/4"	11.275	185	2000 psi	145 bar	2000 psi	145 bar
3	3"	12.3	201	2000 psi	145 bar	2000 psi	145 bar

MH50/51 SERIES GEAR HOUSING PORTS

NOTE

* N.P.T. PORTING IS NOT RECOMMENDED FOR PRESSURES ABOVE 1500 P.S.I.

* Ports marked with a “X” are recommended porting, for all other porting please consult the factory

* SHADED CELLS ARE GOOD FOR MOTOR UNITS

* ORIENTATION IS VIEWED FROM THE SHAFT END

NPT.CODE	PORT LEFT	PORT RIGHT	5	7	10	12	15	17	20	22	25
AB	NONE	NONE	X	X	X	X	X	X	X	X	X
IC	3/4"	NONE			X						
ID	NONE	3/4"			X	X	X	X			
IF	3/4"	3/4"			X	X	X	X	X		
IG	3/4"	1"			X	X	X				
IH	3/4"	1 1/4"					X				
IJ	1"	3/4"			X	X	X	X	X		
IK	1 1/4"	3/4"					X				
YC	1"	NONE				X	X	X	X	X	
YD	NONE	1"				X	X	X	X	X	
YF	1"	1"				X	X	X	X	X	X
YG	1"	1 1/4" *					X	X	X	X	
YH	1"	1 1/2"									X
YJ	1 1/4" *	1"					X	X	X	X	X
YK	1 1/2"	1"									X
IA	1 1/4" *	NONE					X	X	X	X	X
IB	NONE	1 1/4" *					X	X	X	X	X
YL	1 1/4"	1 1/4"						X	X	X	X
YM	1 1/4"	1 1/2" *							X	X	X
YP	1 1/2"	1 1/4"							X	X	X
YR	1 1/2"	1 1/2"							X	X	X
YA	1 1/2"	NONE							X	X	X
YB	NONE	1 1/2"							X	X	X

BSPP.CODE	PORT LEFT	PORT RIGHT	05	07	10	12	15	17	20	22	25
AB	NONE	NONE	X	X	X	X	X	X	X	X	X
YN	3/4"	NONE			X	X					
YQ	NONE	3/4"			X	X	X	X			
YS	3/4"	3/4"				X	X				X
YT	3/4"	1"			X	X	X				
YU	3/4"	1 1/4"			X	X	X	X			
YV	1"	3/4"			X	X	X	X	X		
YW	1 1/4"	3/4"			X	X	X	X			
SL	1"	NONE			X	X	X				
RQ	NONE	1"					X	X	X	X	X
MP	1"	1"					X	X	X	X	X
VY	1"	1 1/4" *					X	X	X	X	X
IX	1 1/4" *	1"					X	X	X	X	X
NJ	1 1/4" *	NONE					X	X	X		
UI	NONE	1 1/4" *								X	X
PF	1 1/4"	1 1/4"								X	X
IQ	1 1/4"	1 1/2"									X
IS	1 1/2"	1 1/4"									X

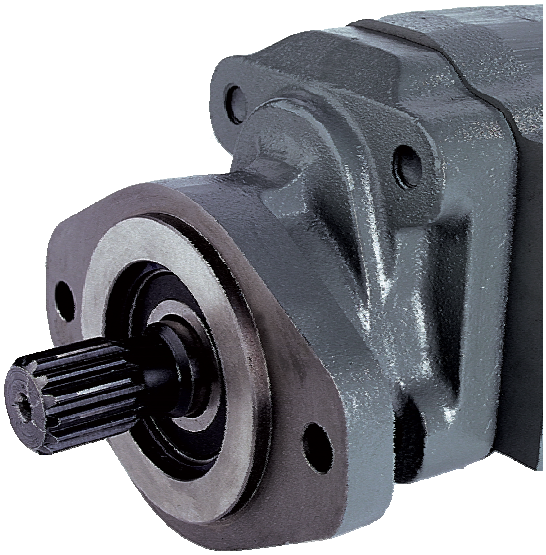
MH50/51 SERIES GEAR HOUSING PORTS

O.D TUBE.CODE	PORT LEFT	PORT RIGHT	05	07	10	12	15	17	20	22	25
AB	NONE	NONE	X	X	X	X	X	X	X	X	X
EC	3/4"	NONE			X	X	X	X	X		
ED	NONE	3/4"			X	X	X	X	X		
EF	3/4"	3/4"			X	X	X	X	X		
EG	3/4"	1"			X	X	X				
EH	3/4"	1 1/4"					X	X			
EJ	1"	3/4"			X	X	X	X	X		
EK	1 1/4"	3/4"					X	X			
AC	1"	NONE			X	X	X	X			
AD	NONE	1"			X	X	X	X			
AF	1"	1"					X	X	X	X	X
AG	1"	1 1/4" *					X	X	X	X	X
AH	1"	1 1/2"						X	X	X	
AJ	1 1/4" *	1"					X	X	X	X	X
AK	1 1/2" *	1"					X	X	X	X	X
AL	1 1/4"	1 1/4"							X	X	X
AM	1 1/4"	1 1/2" *							X	X	X
AP	1 1/2" *	1 1/4"							X	X	X
AR	1 1/2"	1 1/2"									X
AA	1 1/4" *	NONE					X	X	X	X	X
AO	NONE	1 1/4" *					X	X	X	X	X
AE	1 1/2" *	NONE							X	X	
AU	NONE	1 1/2" *							X	X	

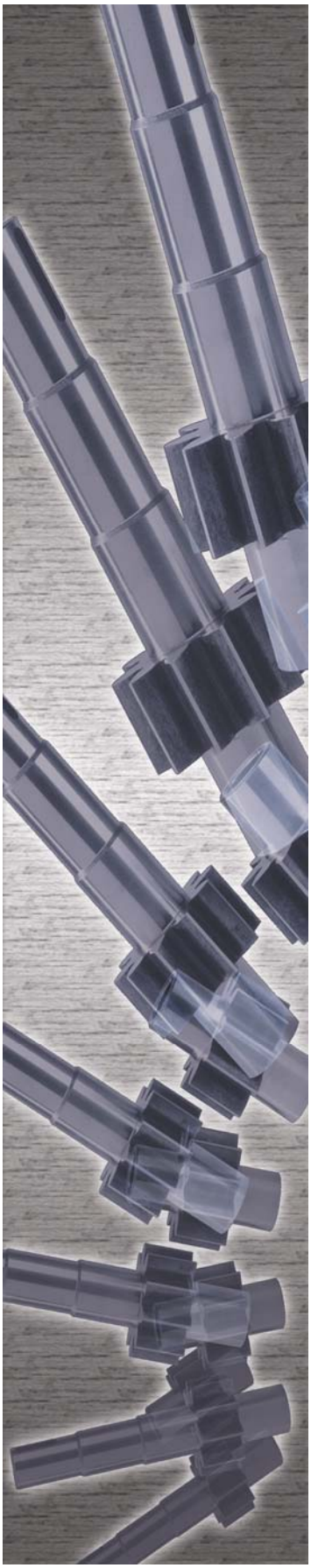
METRIC STR. THD.	PORT LEFT	PORT RIGHT	05	07	10	12	15	17	20	22	25
AB	NONE	NONE	X	X	X	X	X	X	X	X	X
EN	3/4"	NONE			X	X	X	X			
TQ	NONE	3/4"			X	X	X	X			
ES	3/4"	3/4"			X	X					
ET	3/4"	1"			X	X	X	X	X		
EV	1"	3/4"			X	X	X	X	X		
NL	1"	NONE					X	X	X	X	
ER	NONE	1"					X	X	X	X	
CM	1"	1"					X	X	X		
VE	1"	1 1/4" *					X	X	X	X	X
EX	1 1/4" *	1"					X	X	X	X	X
UA	NONE	1 1/4"							X	X	X
PA	1 1/4"	1 1/4"							X	X	X
QA	1 1/4"	1 1/2" *							X	X	X
SA	1 1/2"	1 1/4"							X	X	X

MH50/51 SERIES GEAR HOUSING PORTS

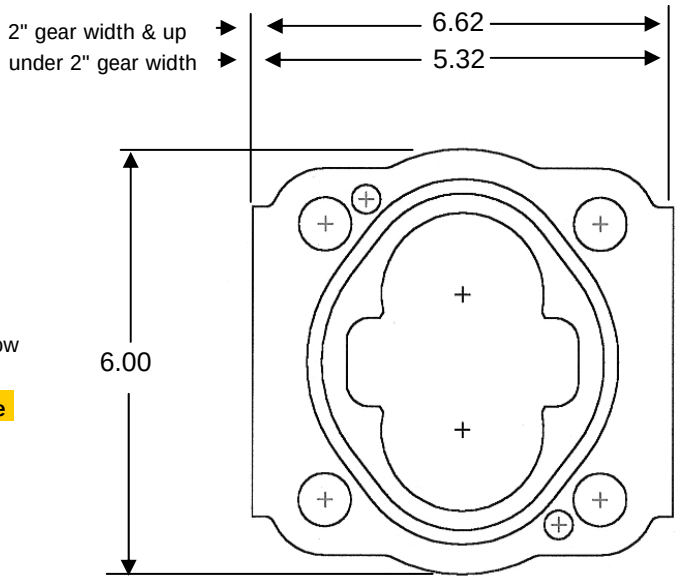
SPLIT FLANGE	PORT LEFT	PORT RIGHT	05	07	10	12	15	17	20	22	25
AB	NONE	NONE	X	X	X	X	X	X	X	X	X
UC	3/4"	NONE			X	X	X	X			
UD	NONE	3/4"			X	X	X	X			
UF	3/4"	3/4"			X	X	X	X	X	X	X
UG	3/4"	1"			X	X	X				
UH	3/4"	1 1/4"				X	X	X			
UJ	1"	3/4"			X	X	X	X	X		
UK	1 1/4"	3/4"				X	X	X			
OC	1"	NONE			X	X	X	X	X	X	X
OD	NONE	1"			X	X	X	X	X	X	X
OF	1"	1"				X	X	X	X	X	X
OG	1"	1 1/4" *				X	X	X	X		
OH	1"	1 1/2" *					X	X	X	X	X
OJ	1 1/4" *	1"				X	X	X	X	X	X
OK	1 1/2" *	1"					X	X	X	X	X
OL	1 1/4"	1 1/4"					X	X	X	X	X
OM	1 1/4"	1 1/2" *					X	X	X	X	X
ON	1 1/4"	2"							X	X	X
OP	1 1/2" *	1 1/4"					X	X	X	X	X
OQ	2"	1 1/4"							X	X	
OR	1 1/2"	1 1/2"						X	X	X	X
OS	1 1/2"	2"							X	X	X
OV	2"	1 1/2"							X	X	X
OX	2"	2"									X
OA	1 1/4" *	NONE				X	X	X	X	X	X
OB	NONE	1 1/4" *				X	X	X	X	X	X
OE	1 1/2" *	NONE					X	X	X	X	X
OU	NONE	1 1/2" *					X	X	X	X	X
UB	1"	2"							X	X	X
UQ	2"	1"							X	X	X
XB	2"	NONE							X	X	X
ZB	NONE	2"							X	X	X



MH50/51 SERIES GEAR HOUSING PORTS



METRIC S. F.	PORT LEFT	PORT RIGHT	05	07	10	12	15	17	20	22	25
AB	NONE	NONE	X	X	X	X	X	X	X	X	X
VN	3/4"	NONE			X	X	X	X			
VQ	NONE	3/4"			X	X	X	X			
VS	3/4"	3/4"			X	X	X				
VT	3/4"	1"			X	X	X	X	X		
RV	1"	3/4"			X	X	X	X	X		
RU	3/4"	1 1/4"			X	X	X				
RW	1 1/4"	3/4"			X	X	X				
UL	1"	NONE				X	X	X	X	X	
UR	NONE	1"				X	X	X	X	X	
UM	1"	1"				X	X	X	X	X	
VU	1"	1 1/4" *				X	X	X	X	X	X
UX	1 1/4" *	1"				X	X	X	X	X	X
HO	1"	1 1/2" *					X	X	X		
VO	1 1/2" *	1"					X	X	X		
NO	1 1/4" *	NONE						X	X	X	X
UO	NONE	1 1/4" *						X	X	X	X
PO	1 1/4"	1 1/4"					X	X	X	X	X
QO	1 1/4"	1 1/2" *					X	X	X	X	X
SO	1 1/2" *	1 1/4"					X	X	X	X	X
JR	1 1/4"	2"							X	X	X
JM	2"	1 1/4"							X	X	X
UY	1 1/2" *	NONE					X	X	X	X	
TO	NONE	1 1/2" *					X	X	X	X	
SV	1 1/2"	1 1/2"							X	X	X
JN	1 1/2"	2"							X	X	X
JQ	2"	1 1/2"							X	X	X



The width of the gear housing listed below

Gear size	Housing size
1/2" Gear Size	1.25
3/4" Gear Size	1.50
1" Gear Size	1.75
1 1/4" Gear Size	2.00
1 1/2" Gear Size	2.25
1 3/4" Gear Size	2.50
2" Gear Size	2.75
2 1/4" Gear Size	3.00
2 1/2" Gear Size	3.25

MH50/51 SERIES CODING

8 SHAFT TYPE CODE	
07	S.A.E. "C" 14 TOOTH SPLINE 1.250" dia
11	S.A.E. "C" KEYED 1.25" dia 5/16" X 15/32" X1 1/2" KEY
25	S.A.E. "B" 13 TOOTH SPLINE .88" dia
43	S.A.E. B B KEYED 1" dia. 1/4" X 3/8" X 1 1/4" KEY
53	S.A.E. C 14 TOOTH SPLINE 1.25" dia.
65	S.A.E. "B" 13 TOOTH SPLINE .875" dia TYPE 2
67	S.A.E. B B KEYED 1" dia. 1/4" X 3/8" X 1 1/4" KEY TYPE 2
73	S.A.E. "C" KEYED 1.25" dia 5/16" X 15/32" X 2 1/4" KEY
98	S.A.E. B B 15 TOOTH SPLINE 1" dia. — CONTINENTAL ONLY

7 GEAR SIZE MH 50 / 51			
		50	51
MH 50/51	CU. IN.	MAX. PSI	MAX. PSI
07	1.91	2500 PSI	3000 PSI
10	2.55	2500 PSI	3000 PSI
12	3.19	2500 PSI	3000 PSI
15	3.83	2500 PSI	3000 PSI
17	4.46	2000 PSI	3000 PSI
20	5.10	2000 PSI	2500 PSI
22	5.74	2000 PSI	2500 PSI
25	6.38	2000 PSI	2500 PSI

9 BEARING CARRIERS ORIENTATION IS FROM THE SHAFT END

N.P.T.

IN	OUT	CW	CCW
NONE	NONE	C	D
NONE	NONE	A	U
1"	NONE	TB	BT
1 1/4"	NONE	VB	BV
1 1/2"	NONE	WB	BW
1"	3/4"	TX	XT
1 1/4"	3/4"	VX	XV
1 1/2"	3/4"	WX	XW
1 1/4"	1"	VZ	ZV
1 1/2"	1"	WZ	ZW
1"	3/4"	TJ	JT
1 1/4"	3/4"	VJ	JV
1 1/4"	1"	VK	KV
1 1/2"	1"	WK	KW
1"	3/4"	ZX	XZ

S.A.E. O RING

1"	NONE	CB	BC
1 1/4"	NONE	DB	BD
1 1/2"	NONE	FB	BF
NONE	3/4"	PJ	JP
1"	3/4"	CJ	JC
1 1/4"	3/4"	DJ	JD
1 1/2"	3/4"	FJ	JF
1 1/4"	1"	DK	KD
1 1/2"	1"	FK	KF
1"	3/4"	CR	RC

S.A.E. SPLIT FLANGE

IN	OUT	CW	CCW
1"	NONE	LB	BL
1 1/4"	NONE	MB	BM
1 1/2"	NONE	NB	BN
NONE	3/4"	BR	RB
1"	3/4"	LR	RL
1 1/4"	3/4"	MR	RM
1 1/2"	3/4"	NR	RN
1 1/4"	1"	MS	SM
1 1/2"	1"	NS	SN
1"	3/4"	LX	XL
1 1/4"	3/4"	MX	XM
1 1/4"	1"	MZ	ZM
1 1/2"	1"	NZ	ZN
1"	3/4"	SR	RS

MOTORS ONLY

IN	OUT	DUAL	
NONE	NONE	B	
1"	1"	TT	NPT
1 1/4"	1 1/4"	VV	NPT
1 1/2"	1 1/2"	WW	NPT
1"	1"	CC	SAE O RING
1 1/4"	1 1/4"	BB	SAE O RING
1 1/2"	1 1/2"	FF	SAE O RING
1"	1"	LL	SAE SPLIT FLANGE
1 1/4"	1 1/4"	MM	SAE SPLIT FLANGE
1 1/2"	1 1/2"	NN	SAE SPLIT FLANGE

10 CONNECTING SHAFT USE CODE #1 FOR ALL MULTIPLE UNITS

FOR PIGGYBACK UNITS CONTACT PRODUCT SUPPORT

Moduflow™ *Plus* Series

ILP and RFP Low Pressure Filters

Applications for Moduflow Filters

- Power Unit Fabrication
- Off-line Filter Loops
- Mobile Equipment

The Moduflow filter is widely considered the most versatile filter available on the market. The unique diverter valve assembly, and inside to outside flow through the element, allows the Moduflow to be configured for in-line, in-tank or suction filtration.

The flow diverter minimizes turbulence and pressure loss through the filter, improving system performance.

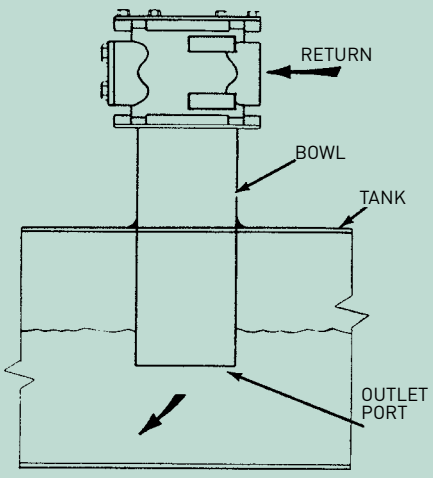
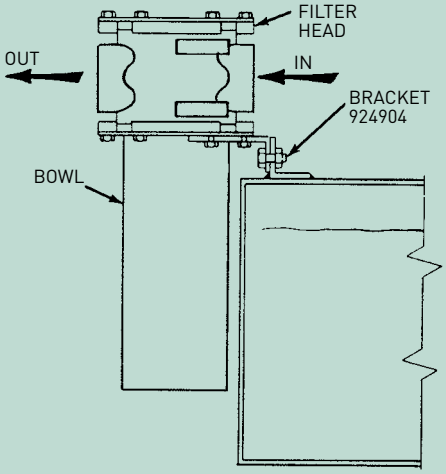
The newly designed closed bottom elements for the RFP and ILP models insures all contamination remains trapped within the element as the filter is serviced.

A wide variety of visual and electrical indicators allows you to know exactly when the element needs to be serviced. There is even a "no element" indicator that can sense when there is not an element installed in the filter.

From top to bottom, the Moduflow filter series provides the high level of filtration and long term dependability so vital to today's hydraulic systems.

Parker's new patented Moduflow element was designed with built-in diverter cone and bypass valve, to meet your application needs.

Mounting / Porting Styles

RFP Return Filter	ILP In-Line Filter
	

Parker Hannifin Corporation
Hydraulic Filter Division
Metamora, OH

Features

Flanges
- NPT or SAE ¾" to 2"
- Lightweight aluminum

Cover
- Slotted for quick release
- Lightweight aluminum

Indicators
- Visual or electrical
- Mounted on either side
- Standard "no element" indication

Bowl
- Single or double length
- Durable steel construction

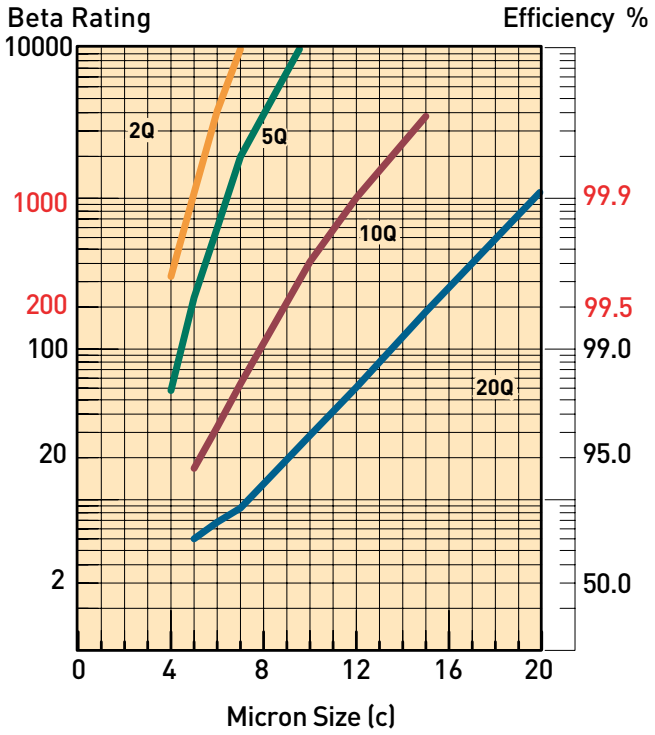
Bypass
(not visible)
- Integral 35 psi bypass replaced with every element change

Element
(not visible)
- Available in cellulose, wire mesh or high performance Microglass III media
- Single or double length

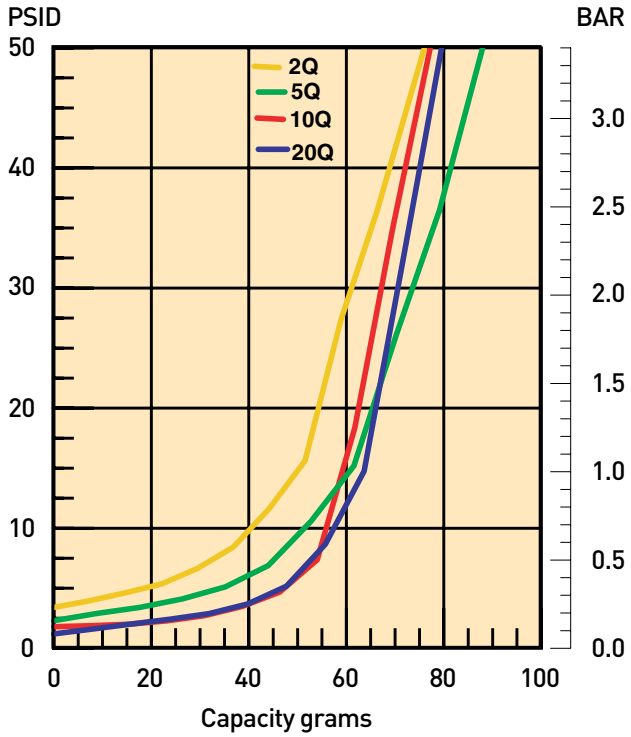
Feature	Advantage	Benefit
• Top access element service	• Oil remains in housing • Quicker elements change	• No Spills • Reduced maintenance costs
• Slotted cover	• Quick release cover • Cap screws remain in housing	• Reduced maintenance costs • No loose parts to lose
• Closed bottom elements	• Removes all contaminant during element service	• No downtime contamination from servicing
• Visual or electrical indicators	• Know exactly when to service elements	• Helps prevent bypass condition • No premature disposal
• Flange face ports	• Flexible mounting (3/4" to 2")	• Easy plumbing to your system

RFP-1 & ILP-1 Element Performance

Efficiency

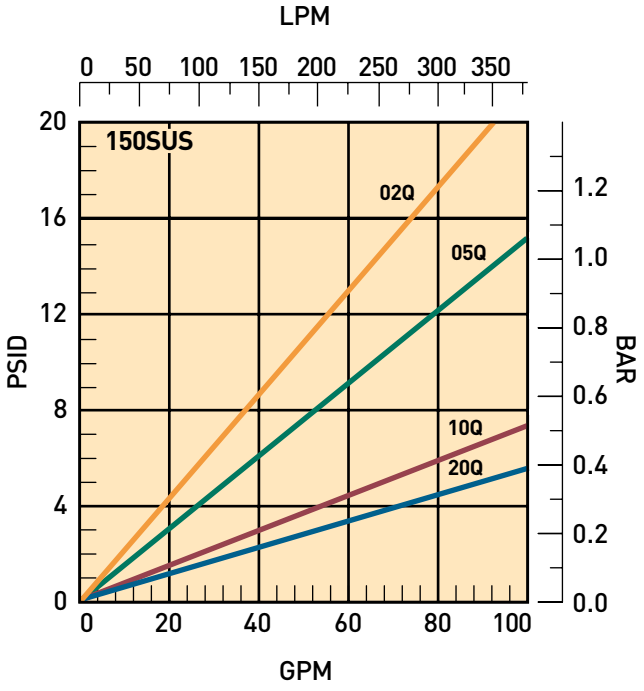


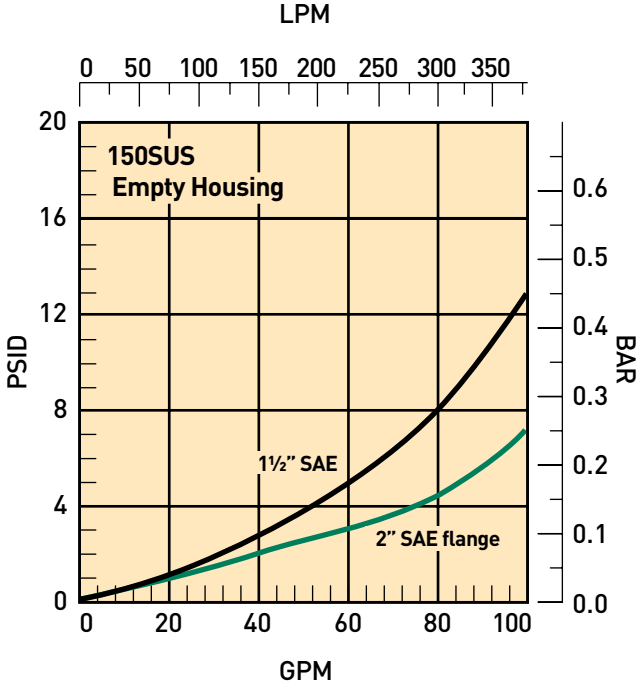
Capacity



Multipass tests run @ 40 gpm to 50 psid terminal - 5mg/L BUGL

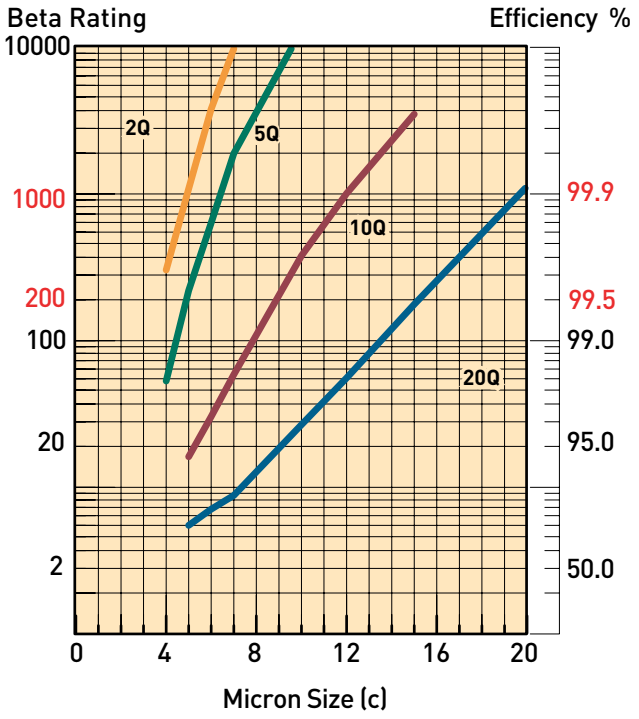
Flow vs. Pressure Loss



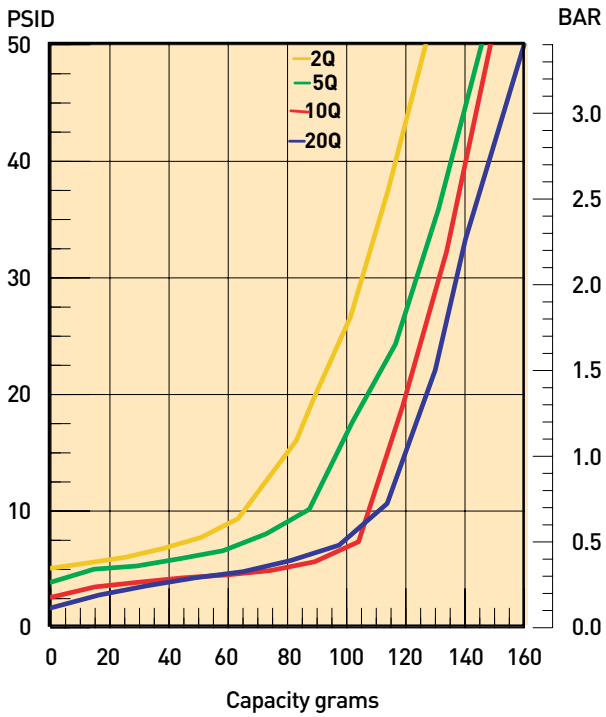


RFP-2 & ILP-2 Element Performance

Efficiency

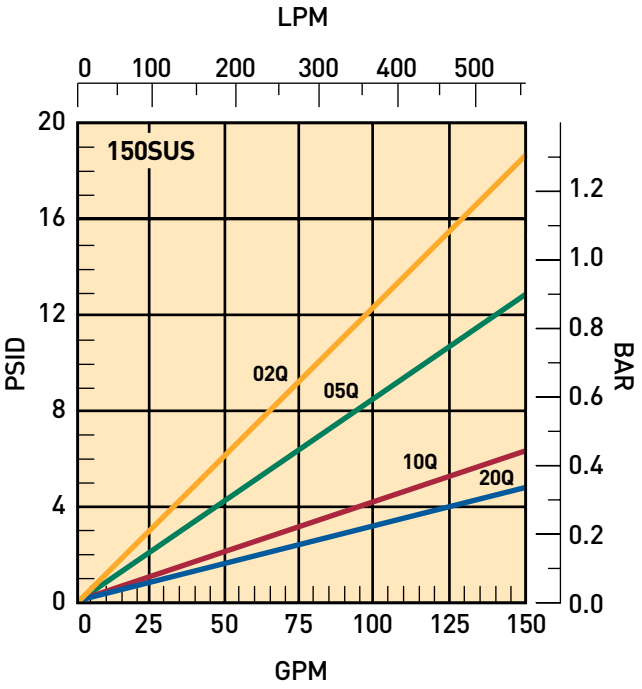


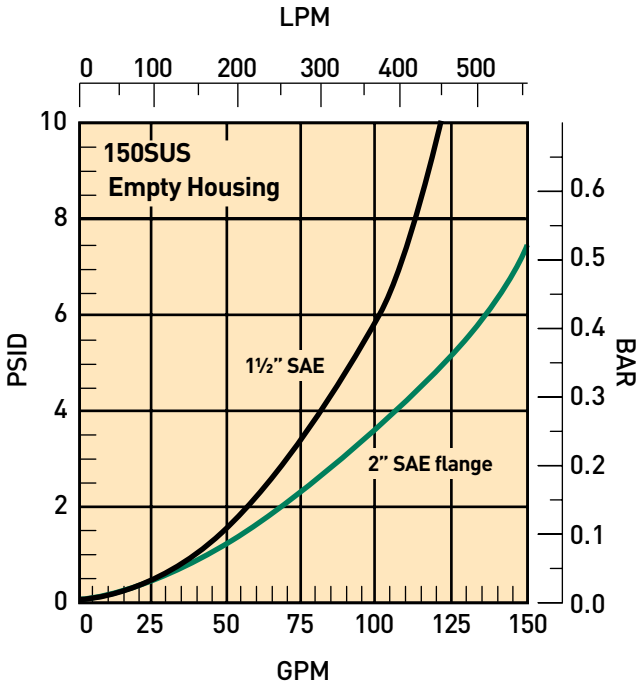
Capacity



Multipass tests run @ 80 gpm to 50 psid terminal - 5mg/L BUGL

Flow vs. Pressure Loss





Specifications: RFP, ILP

Pressure Ratings:
Maximum Allowable Operating Pressure (MAOP): 200 psi (13.8 bar)
Design Safety Factor: 2:1
Rated Fatigue Pressure: 150 psi (10.3 bar)

Element Burst Rating: 70 psid (4.8 bar)

Filter Materials:
Head, Cover, Flanges: die cast aluminum
Bowl: steel

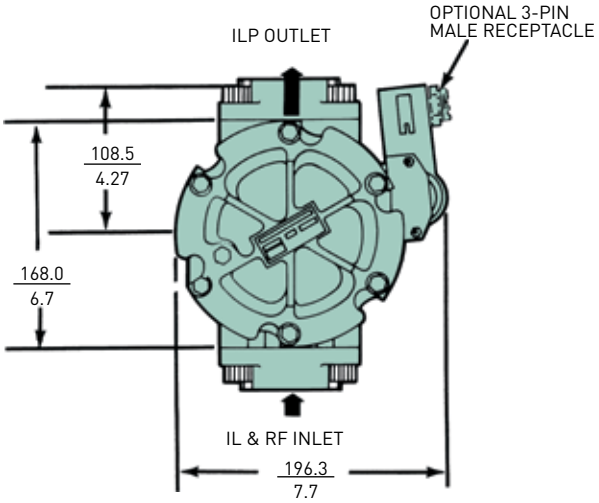
Operating Temperatures:
Nitrile: -40°F to 225°F (-40°C to 107°C)
Fluorocarbon: -15°F to 275°F (-26°C to 135°C)

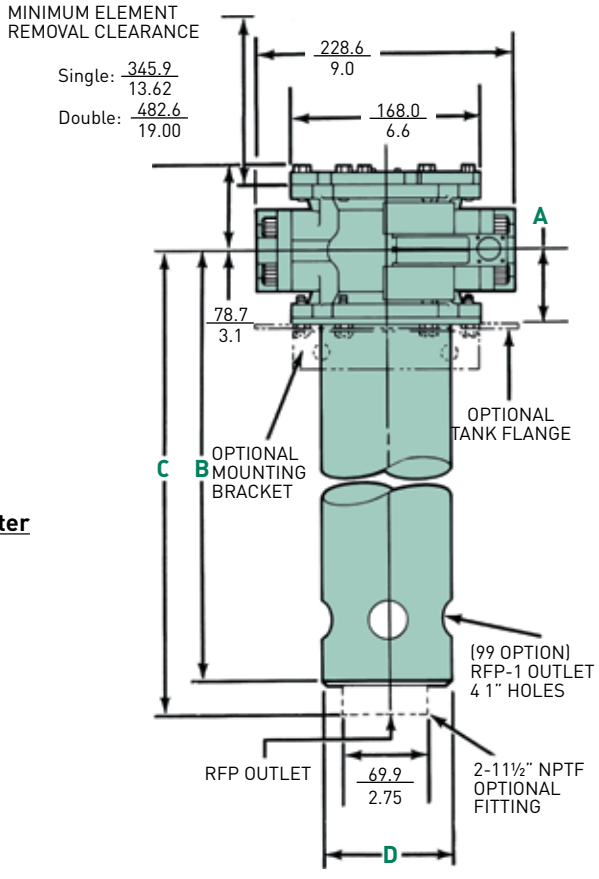
Weight (approximate):
Single: 20 lbs. (9.1 kg)
Double: 25 lbs. (11.3 kg)

Indicators:
Visual (optional)
Electrical (optional) 15A @ 250VAC / .5A @ 125 VDC
Electrical ("D" option) 5A @ 250VAC / 3A @ 28 VDC

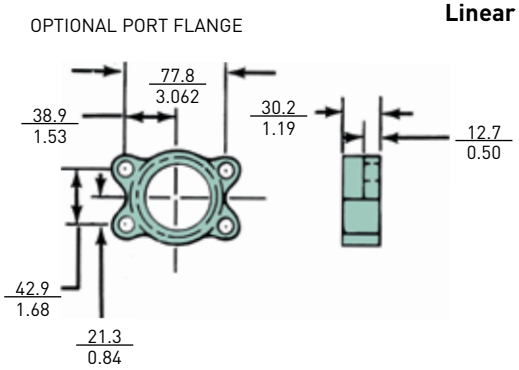
Color Coding:
White (normally closed)
Red (normally open)
Black (common)

	Dimensions: mm / inch			
Model	**A**	**B**	**C**	**D**
RFP-1 without optional 2" fitting	65.0 / 2.56	330.2 / 13.0	–	110.0 / 4.3
ILP-1	65.0 / 2.56	330.2 / 13.0	N/A	110.0 / 4.3
RFP-1 with optional 2" fitting	68.3 / 2.69	–	383.4 / 15.07	114.0 / 4.5
RFP-2	68.3 / 2.69	617.5 / 24.31	623.8 / 24.56	114.0 / 4.5
ILP-2	68.3 / 2.69	617.5 / 24.31	N/A	114.0 / 4.5





Linear Measure: millimeter / inch



Parker Hannifin Corporation
Hydraulic Filter Division
Metamora, OH

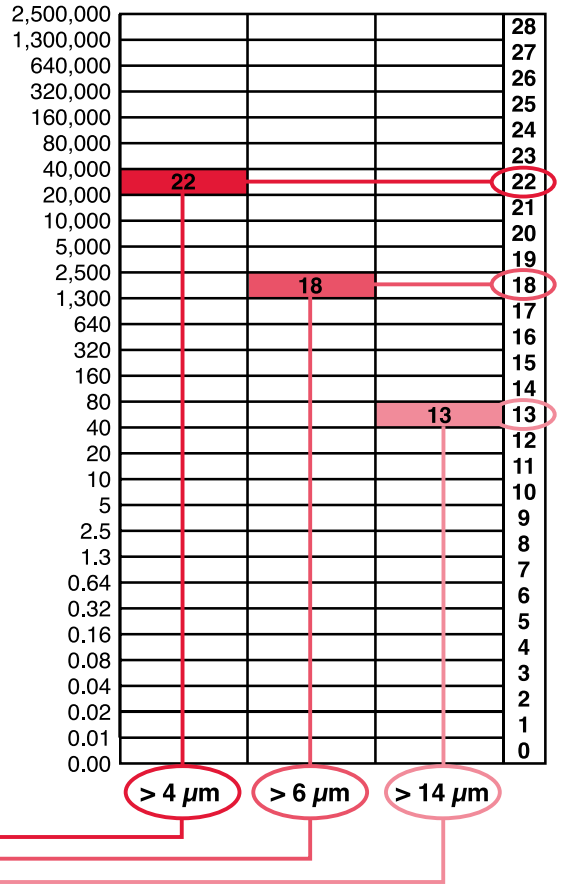
ISO 4406 Code

Cleanliness levels are defined by three numbers divided by slashes (/.) These numbers correspond to 4, 6, and 14 micron, in that order. Each number refers to an ISO Range Code, which is determined by the number of particles for that size (4,6, & 14µm) and larger present in 1 ml of fluid. Each range is double the range below. Refer to the chart below to see the actual ranges.

Example:

larger than 4µm = 22,340
larger than 6µm = 1,950
larger than 14µm = 43

ISO Code = 22 / 18 / 13



Achieving the appropriate cleanliness level in a system

The only way to achieve and maintain the appropriate cleanliness level in a hydraulic or lubrication system, is to implement a comprehensive filtration program. HYDAC offers all of the products that are needed to do just that! - They include:

Solid Contamination

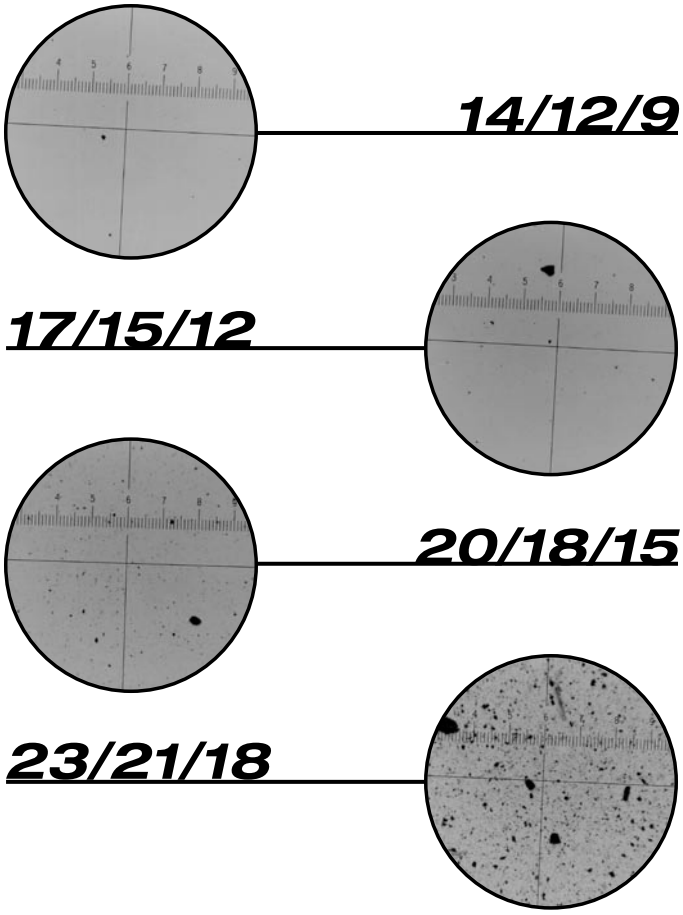
- pressure filters
- return line filters
- offline filtration loops
- oil transfer units for precleaning of new oil
- portable and online contamination monitors
- reservoir breathers and filler/breathers

Water Content

- water content sensors
- reservoir breathers with silica gel desiccant
- vacuum dehydration water removal units
- water removal elements

Fluid Analysis

- bottle sampling kits
- complete analysis kits



Finding the cleanliness level required by a system

1. Starting at the left hand column, select the most sensitive component used in the system.
2. Move to the right to the column that describes the system pressure and conditions.
3. Here you will find the recommended ISO class level, and recommended element micron rating.

	Low/Medium Pressure Under 2000 psi (moderate conditions)		High Pressure 2000 to 2999 psi (low/medium with severe conditions[1])		Very High Pressure 3000 psi and over (high pressure with severe conditions[1])	
	ISO Target Levels	Micron Ratings	ISO Target Levels	Micron Ratings	ISO Target Levels	Micron Ratings
Pumps						
Fixed Gear or Fixed Vane	20/18/15	20	19/17/14	10	18/16/13	5
Fixed Piston	19/17/14	10	18/16/13	5	17/15/12	3
Variable Vane	18/16/13	5	17/15/12	3	not applicable	not applicable
Variable Piston	18/16/13	5	17/15/12	3	16/14/11	3[2]
Valves						
Check Valve	20/18/15	20	20/18/15	20	19/17/14	10
Directional (solenoid)	20/18/15	20	19/17/14	10	18/16/13	5
Standard Flow Control	20/18/15	20	19/17/14	10	18/16/13	5
Cartridge Valve	19/17/14	10	18/16/13	5	17/15/12	3
Proportional Valve	17/15/12	3	17/15/12	3	16/14/11	3[2]
Servo Valve	16/14/11	3[2]	16/14/11	3[2]	15/13/10	3[2]
Actuators						
Cylinders, Vane Motors, Gear Motors	20/18/15	20	19/17/14	10	18/16/13	5
Piston Motors, Swash Plate Motors	19/17/14	10	18/16/13	5	17/15/12	3
Hydrostatic Drives	16/15/12	3	16/14/11	3[2]	15/13/10	3[2]
Test Stands	15/13/10	3[2]	15/13/10	3[2]	15/13/10	3[2]
Bearings						
Journal Bearings	17/15/12	3	not applicable	not applicable	not applicable	not applicable
Industrial Gearboxes	17/15/12	3	not applicable	not applicable	not applicable	not applicable
Ball Bearings	15/13/10	3[2]	not applicable	not applicable	not applicable	not applicable
Roller Bearings	16/14/11	3[2]	not applicable	not applicable	not applicable	not applicable

1. Severe conditions may include high flow surges, pressure spikes, frequent cold starts, extremely heavy duty use, or the presence of water
2. Two or more system filters of the recommended rating may be required to achieve and maintain the desired Target Cleanliness Level.

FREE Poster!

The information on these two pages is also available on our **ISO Cleanliness Guidelines** poster.

Visit our web site to request your FREE copy.

www.hydacusa.com/poster